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# Intérêt épidémiologique de la recherche des bactériophages dans les eaux

par le Prof. Ch. GERNEZ—RIEUX, R. BUTTIAUX et Melle  
G. MUCHEMBLE.

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L'eau est un des vecteurs de certains germes pathogènes produisant chez l'homme et les animaux des maladies infectieuses, transmissibles soit par absorption soit par contact avec la peau ou les muqueuses. Au point de vue épidémiologique, le groupe le plus important de ces maladies est représenté par certaines „Salmonelloses” et en particulier les fièvres typhoïdes et paratyphoïdes. L'eau contaminée par le B. Eberth ou les B. paratyphiques est l'agent infectant le plus souvent responsable dans ces cas. Il est donc fort important de pouvoir mettre en évidence ces microbes dans les eaux suspectées responsables des épidémies de typhoïde ou paratyphoïde.

La recherche du germe lui-même est encore actuellement considérée comme difficile et souvent aléatoire. Ceci, surtout pour deux raisons: la très petite quantité de microbes pathogènes en circulation; la difficulté de leur développement sur les milieux de culture où ils sont gênés par l'abondance des germes saprophytes qui pullulent dans les eaux contaminées. On obvie à ces deux inconvénients par la concentration des microbes dans l'eau, d'une part, et par la culture sur des milieux d'enrichissement d'abord, et électifs ensuite, qui bloquent la végétation des saprophytes et facilitent au contraire celle des pathogènes. L'emploi de ces procédés nous a fourni d'heureux résultats dans l'étude bactériologique des eaux superficielles de la „poche de Dunkerque” au cours des inondations provoquées par l'armée allemande en 1944—1945. Nous avons pu ainsi déceler dans ces eaux un Bacille d'Eberth et un Bacille dysentérique de Flexner. En outre, nous avons isolé un Bacille de Morgan, agent de syndromes dysentériques. Ce dernier microbe a été mis en évidence, d'une façon constante, au cours d'examens répétés, sur une étendue de plus de 15 km. de voies d'eau, dans la nappe des „Moeres” et dans les exutoires qui l'évacuaient jusque dans le Port de Dunkerque. (1) — (2) —

Cependant, ces recherches nouvelles sont longues et répétitives, encore aléatoires. Le plus souvent, dans ces conditions, on se contente de rechercher dans les eaux suspectes les microbes

banaux indiquant les contaminations fécales, c'est-à-dire des germes aérobies comme le B. Coli et l'Enterocoque, et un des germes anaérobies les plus fréquents, le B. Perfringens — On admet que les eaux contenant ces microbes peuvent également contenir les germes pathogènes tels que les Salmonella ou les Bacilles dysentériques éliminés par les matières fécales d'animaux ou d'hommes malades et porteurs de ces germes. Pourtant, on le conçoit facilement, cette hypothèse ne satisfait pas pleinement l'esprit et en tout cas ne permet pas d'acquérir une certitude absolue en épidémiologie.

Il est par contre un moyen indirect de recherche des germes pathogènes dans les eaux qui donne déjà de bons résultats et est appelé, nous le pensons, à se généraliser dans l'avenir. Il s'agit de la mise en évidence des bactériophages spécifiques pour ces germes pathogènes.

On désigne sous le nom de bactériophage, un principe lytique filtrable, transmissible en série, qui détermine la lyse du microbe sur lequel il est actif. Chacun sait que le mérite de sa découverte revient à d'HERELLE (3). Cette lyse se différencie de celle produite par des agents chimiques ou physiques en ce qu'elle peut se transmettre par repiquages successifs. Autrement dit, si une eau contient un phage actif pour le B. Eberth, elle produira, in vitro, la lyse d'une culture de ce B. Eberth en milieu de culture solide ou liquide. Dans ce dernier cas, le liquide obtenu après cette lyse, filtré sur bougie et remis en présence de la culture du B. Eberth, reproduira sa lyse, même, si, à ce moment, la quantité de liquide filtré employée est infime. Par de tels passages en série, non seulement le bactériophage reste lytique mais son pouvoir lysant augmente considérablement. Un phage isolé d'une eau, actif pour le B. Eberth à la dilution de 1/20 au début, lysera ce même microbe à un taux de dilution de 1/1.000.000 ou plus après 3 ou 4 passages successifs ainsi pratiqués.

Bien plus, étudiés dans certaines conditions précises, les phages manifestent une action lytique étroitement spécifique pour un microbe déterminé. Cette spécificité est extrême et est utilisée maintenant en pratique bactériologique courante sous le nom de „phage typing”. En effet, on pense et l'on sait qu'il existe en réalité un phage actif, d'une façon élective, pour chaque fraction antigénique constituant d'un germe donné. Les Salmonella possèdent, on le sait, de nombreux antigènes différents, qui se comptent dans le corps microbien, à la façon d'une mosaïque, selon l'expression de Nicole. Il existe des bactériophages spécifiques pour chaque fragment de cette mosaïque. On ne les met d'ailleurs en évidence qu'en s'entourant de précautions spéciales; c'est le cas des phages Vi qui n'agissent que sur les antigènes Vi des B. Eberth. Ils ont été bien étudiés par CRAIGIE et YEN et par FELIX. (4) — (5). En pratique courante, la seule qui nous inté-



resse, il faut retenir que tel phage lysant un B. Eberth n'aura en général pas d'action sur un B. Paratyphique B ou un B. Paratyphique A.

Cependant, les travaux de FELIX, de CRAIGIE et YEN tendent à montrer que la spécificité du phage dépasse en quelque sorte, celle du complexe sérologique antigène — anticorps. Le phage Vi serait propre à un microbe déterminé pris non pas dans le genre mais dans le type microbien lui-même. En d'autres termes, on peut par l'emploi des bactériophages Vi, distinguer des variétés de Bacilles d'Eberth, chacune étant lysée par un phage déterminé qui, dans des conditions précises d'emploi, sera sans action sur une autre variété. FELIX, CRAIGIE & YEN ont ainsi isolé et entretiennent toute une série de phages distincts qui leur fournissent des renseignements étiologiques très importants dans les recherches épidémiologiques. On pourra, par exemple, déterminer, au cours d'une épidémie de typhoïde, si tous les germes isolés sont sensibles au même bactériophage Vi, ce qui fera penser à une contamination unique et identique; ou au contraire, si les B. Eberth isolés chez des malades répondent à des phages différents et dans ce cas on pensera à des origines de contamination diverses. De même, si l'on isole dans une eau contaminée, un B. Eberth sensible au même phage que tous les germes trouvés chez les malades, on sera en droit de penser que c'est bien l'eau souillée qui a produit par son absorption, les typhoïdes humaines.

HUTCHINSON (5 bis) a précisé la valeur de l'identification des bacilles Paratyphiques B par le bactériophage dans une épidémie de fièvre paratyphoïde. On voit le puissant intérêt de cette méthode du „phage-typing”. Son application se généralise d'ailleurs en ce moment. On obtient des résultats semblables dans l'étude des Staphylocoques comme l'ont bien montré WILSON et ATKINSON (6) et Mac DONALD (7). C'est ainsi que dans une observation présentée à la Société Belge de Gastro-entérologie, l'un de nous a pu démontrer qu'un Staphylocoque isolé des selles d'une malade contaminée par l'absorption d'une pâtisserie de mauvaise qualité était différent du Staphylocoque isolé du rhino-pharynx de cette même personne (8). On tend à identifier les différentes variétés de Shigella par le même procédé du phage typing (8 bis).

Cette notion de spécificité du phage doit être complétée, et amendée en quelque sorte, par la notion de „sensibilité” microbienne vis à vis du bactériophage. Il existe en effet certaines espèces microbiennes qui sont plus facilement lysées par ce principe lytique et la plus intéressante à retenir à ce sujet est le Bacille dysentérique de Shiga. Mais dans une même espèce microbienne certaines souches sont plus sensibles que d'autres. Il faut donc, pour la recherche des bactériophages dans les eaux, n'utiliser que des souches sensibles. Nous possédons à l'In-



stitut Pasteur de Lille, une souche de *Shigella dysenterioa*, une souche de *S. Typhi*, une souche de *S. Paratyphi A* et une de *S. Paratyphi B* et une de *B. Coli* qui sont, par suite de leur extrême sensibilité aux bactériophages, employées uniquement à ces recherches. Enfin, il est un écueil à éviter soigneusement, c'est celui de la résistance au phage qui apparaît parfois brutalement dans une souche microbienne, même dans celle de *B. Shiga* et fausse alors complètement les recherches. On l'évitera en testant, de temps en temps, le type microbien qu'on emploie en présence d'un phage spécifique actif de titre connu.

Ces notions générales étant précisées, on comprendra facilement que les recherches du bactériophage dans les eaux n'ont de valeur que si l'expérience montre que la présence de celui-ci est liée intimement à celle du germe sensible. Autrement dit, il faut être sûr de trouver un phage-Eberth dans une eau, équivaut à dire que cette eau contient — ou a contenu — un Bacille d'Eberth. De nombreux travaux ont été consacrés à cette question qui n'est pas encore totalement résolue.

Depuis longtemps, on s'est aperçu que les eaux contenaient des bactériophages actifs pour certains microbes et en particulier pour les Bacilles de Shiga et les *B. Coli*. Nous ne pouvons énumérer, ici, tous les travaux consacrés à cette question. Rappelons ceux de Dumas en 1920 (9) — ARLOING, SEMNE & CHAVANNE (10) NAKASHIMA (11) MANOLIN & COSTIN (12), FEJGIN (13), BILOUET (14), VAGEDES & GILDEMEISTER (15), ROBIC (16). Tous les chercheurs se sont d'abord consacrés à l'aspect strictement bactériologique du problème. Ce n'est que peu à peu que l'on a discerné tout l'intérêt que pouvait présenter la recherche du bactériophage dans les eaux au point de vue épidémiologique ou dans l'évaluation de la qualité bactériologique des eaux potables. A cette importante question: la présence du phage dans l'eau est-elle le signe certain de la contamination par le germe sensible? les auteurs répondent de façon fort différentes. VAGEDES (17), SCHLOSSMAN (18), DIENERT (19), ROBIC (16) considèrent par exemple que la présence de bactériophage anti-Eberth n'implique pas la contamination de l'eau par le bacille typhique. RENAUX (20), GILDEMEISTER & WATANABE (21), COUTURE (22), pensent que la recherche des bactériophages n'a pas de valeur pour le contrôle de l'eau potable. Il est par contre toute une série de chercheurs qui apportent à la présence des phages dans les eaux, une importance grandissante comme test de contamination focale ou de souillure par les germes pathogènes. Ils admettent que la présence d'un bactériophage Shiga dans une eau, *est un indice de pollution fécale certaine* et que, bien souvent, dans des eaux peu contaminées et surtout dans des eaux contaminées d'une façon intermittente, on trouve un phage Shiga alors qu'au même moment, on ne peut mettre en évidence de *B. Coli*. Celui-ci apparaîtra ultérieurement lors d'une aggra-



vation de la contamination de la nappe aquifère. ABDOELRACHMAN (23) trouve que le phage Shiga existe dans un grand nombre de selles de personnes saines et persiste pendant quelque temps dans l'eau polluée par ces matières fécales. Il considère que la recherche de ce phage dans l'eau est un très bon signe de contamination fécale. A l'Institut Pasteur de Paris, Mad. GUELIN, (24) — (25) étudie depuis plusieurs années, les indications fournies par le bactériophage sur l'état sanitaire des eaux. Elle a montré d'une façon nette que la quantité de phage actif dans une eau, pour une souche donnée de B. Coli, était proportionnelle au degré de contamination en B. Coli de cette eau. COCIOBA (26), en Roumanie, montre qu'il n'existe pas de phage dans les eaux indemnes de B. Coli et, pour lui, la mise en évidence d'un bactériophage anti-Coli ou anti-dysentérique est un indice certain de la pollution de l'eau par des matières fécales ou organiques animales.

FLU (26 bis) a isolé dans les eaux résiduaires et dans l'eau du canal de Leiden (Hollande) des phages anti-pestueux. Il explique leur présence par la contamination des eaux par des matières fécales de rats où il a retrouvé ces phages anti-pestueux dans la proportion de 70% des animaux examinés.

Pour notre part, nous nous sommes particulièrement attachés à la recherche des bactériophages lysant les Salmonella. Nous rapporterons deux observations démonstratives à ce sujet. Dans une épidémie de Paratyphoïde B, survenue dans la région du Nord de la France, nous avons trouvé dans une eau de distribution non javellisée, un phage actif pour le B. Paratyphique B isolé d'une hémoculture pratiquée chez l'un des malades. Cette eau, présentait d'ailleurs des signes de contamination manifeste (plus de 10.000 germes totaux par 1 cc — 100.000 B. Coli Communis par 1.000 ccs. 250 B. Perfringens par 1.000 ccs) et provenait d'une nappe aquifère superficielle siégeant dans un terrain creusé de nombreuses galeries de mines de charbon.

Dans une petite épidémie familiale de Salmonellose, nous avons mis en évidence dans l'eau du puits de la maison, un phage spécifique pour le B. Aertryck (S. typhi murium) qui avait été isolé chez les malades.

Ce court énoncé montre donc, déjà, tout l'intérêt de la recherche des bactériophages dans les eaux. Cet intérêt est considérablement accru du fait que cette recherche est *sensible et simple* dans sa pratique.

La sensibilité plus grande de la recherche du bactériophage par rapport à la recherche du germe lui-même est logique. En effet, si un bactériophage est actif au 1/20e ou au 1/50e dans une eau, dans une même quantité de celle-ci, on devra logiquement mettre en évidence 20 fois ou 50 fois plus facilement le bactériophage que le microbe sensible.

La *simplicité* de la recherche se manifeste dans l'exposé que



nous allons vous en faire. Elle, nécessite cependant quelques précautions. Elle varie suivant qu'il s'agit d'une simple recherche qualitative ou au contraire d'une recherche quantitative, c'est-à-dire d'un dosage de la quantité de phage pour un microbe déterminé contenu dans l'eau analysée.

### 1<sup>o</sup> *Prélèvement de l'échantillon d'eau.*

Les bactériophages sont sensibles à certaines radiations de la lumière solaire qui peuvent, dans certains cas, les inhiber totalement. WAHL (27) a montré que l'écran bleu laisse passer la totalité des radiations actives du spectre solaire sur les phages, tandis que l'écran rouge les bloquait toutes. Dans une nappe d'eau superficielle, le bactériophage peut-être détruit à la surface de la nappe par la lumière solaire. D'autre part l'oxydation a un effet nocif encore peut-être plus marqué. Il est donc indispensable de ne pratiquer le prélèvement qu'à une profondeur d'au moins 30 à 40 centimètres. Le recueil de l'eau sera fait au moyen d'un flacon lesté à ouverture réglée. Ce prélèvement sera effectué dans un flacon stérile et en s'entourant naturellement des précautions d'asepsie indispensables pour éviter toute souillure étrangère à l'eau. Bien que les phages aient une conservation assez longue, il est utile d'en pratiquer la recherche le plus vite possible après le recueil de l'eau.

### 2<sup>o</sup> *Recherche qualitative.*

On désigne ainsi la recherche du phage, sans tenir compte de la quantité présente, pour une série de microbes pathogènes. A l'Institut Pasteur de Lille, nous la pratiquons pour les germes suivants:

B. Shiga — B. Eberth — B. Paratyphique A — B. Paratyphique B — B. Coli Communis.

Ce choix de microbes correspond à celui qui est généralement adopté dans les autres laboratoires, mais il n'est naturellement pas exclusif. C'est ainsi qu'à l'Institut Pasteur de Paris Mme GUELIN recherche les phages des eaux pour le B. Perfringens, germe anaérobie qui est, au même titre que le B. Coli, un excellent indice de la contamination fécale d'une eau. Dans des cas particuliers, on peut tenter de mettre en évidence un phage pour un microbe particulièrement intéressant isolé dans une eau. On a montré ainsi que certains B. Coli dits *Citrobacter* possédaient des phages très spécifiques qu'on pouvait rencontrer dans les eaux qui les hébergent. Nous-mêmes avons entrepris la recherche des phages pour les B. Morgan isolés des eaux de Dunkerque.

Nous préparons 5 ballons de 200 ccs contenant 50 ccs d'une eau peptonée concentrée de la formule suivante:

Peptone sèche .....	60 grs
Cl Na .....	6 grs
Eau distillée .....	1.000 ccs



Le pH est ajusté à 7,5. On stérilise à l'autoclave 20' à 120° C. Nous attirons l'attention sur 2 points importants :

1° / La présence de Cl Na — En effet, l'action lytique des bactériophages ne se produit qu'en présence d'électrolytes. Mme GUELIN (28) a montré que la quantité nécessaire de ceux-ci variait entre un minimum indispensable et un maximum inhibiteur, en passant par un optimum intermédiaire. Cet optimum varie d'ailleurs avec chaque variété de bactériophage.

2° / Le pH — Les bactériophages sont inactivés aux pH bas, voisinant en particulier 4. La vitesse d'inactivation en milieux acides est proportionnelle à la concentration du milieu en ions H. WAHL et BLUM (29) l'ont démontré très nettement sur les bactériophages dits G 16 et S. 13 — On doit cultiver sur milieux légèrement alcalins — Le pH 7,5 paraît, à cet effet, le meilleur.

Chacun de ces 5 ballons est additionné de 50 ccs, d'eau à analyser. Cette dilution, on l'observera, ramène la teneur du mélange à 30 grs/1.000 de peptone et à 3 grs/1.000 de Cl Na. A l'un des ballons, on ajoute alors 2 ou 3 gouttes d'une culture en eau peptonée d'un des 5 microbes signalés ci-dessus. Cette culture est obtenue de la façon suivante : onensemence un tube d'eau peptonée avec la souche sensible au bactériophage de B. Shiga — de B. Eberth — de B. Para B — de B. Para A — de B. Coli — ces souches doivent être exemptes de formes résistantes aux bactériophages. On porte à l'étuve à 37° et on utilise des cultures jeunes, c'est-à-dire les tubes d'eau peptonée où le trouble microbien commence à apparaître d'une façon nette et suffisamment opaque, ce qui se produit généralement en 6 à 8 heures pour le B. Coli et les Salmonella, en 12 à 16 heures pour le B. Shiga. Les ballons du mélange eau + eau peptonée + microbes sont alors placés à l'étuve à 37° durant 10 à 12 heures.

La recherche du bactériophage peut alors se pratiquer de 2 façons : 1° — par filtration du contenu des ballons sur bougies Chamberland L 3. 2° — par chauffage du contenu au bain-marie à 56° durant 30 minutes. Ces 2 opérations ont pour résultat de supprimer la totalité ou la presque totalité des germes qui s'étaient développés dans l'eau peptonée additionnée de l'eau à analyser, tout en y conservant les bactériophages qui sont filtrants ou résistants à la température de 56°. Le chauffage a pour lui l'avantage de la simplicité et de la rapidité d'exécution, mais il laisse subsister des germes thermo résistants qui peuvent gêner la lecture ultérieure. Nous préférons la filtration sur bougie qui nécessite un matériel plus important mais fournit des filtrats rigoureusement stériles.

Dans les filtrats ou dans les flacons chauffés à 56°, la présence du bactériophage est mise en évidence ainsi : on prépare des boîtes de Pétri contenant de la gelose nutritive ordinaire à 15 grs % d'agar et à pH 7,5—7,6. On les laisse sécher quelque temps à l'étuve. On étale soigneusement et le plus uniformément



possible à leur surface, quelques gouttes d'une culture jeune en eau peptonée des microbes choisis. Onensemence donc une boîte avec le B. Shiga — une avec S. Typhi — une avec S. Paratyphi A — une autre avec S. Paratyphi B et une autre enfin avec Escherichia Coli. On laisse sécher durant  $\frac{1}{2}$  heure. Puis au centre de chaque boîte ensemencée, on porte une goutte du filtrat ou du contenu du flacon chauffé correspondant (filtrat Shiga sur plaque Shiga — filtrat Eberth sur plaque Eberth etc...) On recouvre aussitôt les boîtes d'un papier noir pour les protéger de la lumière. On laisse la goutte de filtrat sécher ainsi  $\frac{1}{2}$  heure, puis on porte les boîtes de Pétri retournées à l'étuve à 37°. La lecture se fait après 8 à 10 heures d'incubation. Quand le filtrat contient un phage actif pour le microbe ensemencé, on observe un aspect caractéristique désigné sous le nom de „plage". Il s'agit d'une zone de gelose vierge de toute culture, tracée souvent à l'emporte-pièce dans la nappe de culture microbienne. Elle répond à la région où le phage a lysé le microbe sensible — (figure 1) —

### III. Recherche quantitative:

Elle est identique dans sa pratique à la précédente. Mais, on précise, ici, la quantité de bactériophage que contient l'eau — on ajoute l'eau prélevée dans la proportion de  $\frac{1}{1}$  à de l'eau peptonée concentrée — on répartit le mélange dans une série de tubes à raison de 40 cc, 10 cc, 2 cc.. ce qui correspond à 20 cc, 10 cc, 5 cc... et 1 cc d'eau étudiée. On agit alors comme dans le cas de la méthode qualitative. On recherche le bactériophage dans chacun des tubes, en plaçant une goutte de ceux-ci sur une boîte de Petri ensemencée avec le microbe choisi. On pourra préciser aussi, par exemple, si 1 bactériophage existe dans 1 cc, ou seulement dans 10 cc. ou seulement dans 20 cc de l'eau analysée.

Signalons que, dans toutes ces recherches, on peut tester de nombreux échantillons d'eau sur une même boîte de gélose ensemencée avec le même microbe. Il suffira de recouvrir le dos de la boîte d'un quadrillé et de placer une goutte de chaque eau au centre de chaque carré; on économisera ainsi une quantité appréciable de matériel.

Comme on le voit, toutes ces opérations techniques sont d'une extrême simplicité bactériologique. Elles peuvent être pratiquées dans les laboratoires disposant d'un matériel courant.

Elles fournissent des résultats de lecture toujours très facile et en tout cas indiscutables.

Il semble d'ailleurs que la recherche du bactériophage dans les eaux pourra encore se simplifier. KALTER et ses collaborateurs (30) ont montré que le phage-Coli est très résistant à l'action bactéricide des détergents cationiques du genre Zéphiran, Phémérol, Cétyl pyridinium chloride et Emulsol 607 em-



ployés à des dilutions finales de 1/5.000. Par l'emploi de ces produits, les auteurs sont arrivés à concentrer les phages-Coli dans les eaux résiduaires, bien plus qu'un employant la méthode par filtration. Il sera intéressant de prospector cette façon de faire et d'essayer de l'adapter à la recherche des bactériophages dans les eaux et en particulier dans les eaux de surface très continnées ou boueuses.

La recherche des bactériophages dans les eaux est et sera d'un grand secours en épidémiologie. Nous pensons qu'elle doit maintenant compléter l'analyse bactériologique courante de ces produits. Elle fournira d'utiles renseignements dans les épidémies de Salmonelloses en particulier. D'une façon indirecte, elle permettra de préciser si l'eau doit être considérée comme étant à l'origine de celles-ci. Elle incitera l'hygiéniste à rechercher les causes de contamination fécale de ces eaux. Elle peut être pratiquée sur toutes les variétés d'eaux de consommation (distribution — forage — puits —) Elle est un adjuvant précieux dans l'estimation de la qualité des eaux de baignades ou des piscines (31). Elle constitue, en un mot, à notre avis, une des méthodes d'avenir de l'analyse bactériologique des eaux.

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Figure 1





# Contributions to our Knowledge of British Algae <sup>1)</sup>

by

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## IX. A new Species of *Mougeotia* (*M. Smithii* n. sp.)

The alga forming the subject of this communication was collected by Mr. MALINS SMITH from pools near the lower falls at Aysgarth, Yorkshire in May of 1931. The material was an almost pure culture of a new species of *Mougeotia*, which I have pleasure in naming after its finder. A large proportion of the threads had undergone conjugation and innumerable ripe zygospores were present. The *Mougeotia* belongs to a small group of species, which are characterised by certain peculiarities of the conjugation process, but, although resembling those previously described in various respects, it shows individual differences which necessitate the establishment of a new species.

The vegetative threads consist of narrow elongate cells, 13—17  $\mu$  wide and 6—18 times as long as wide, and are provided with a delicate, though usually evident, mucilage-sheath (fig. 1, A). The copious conjugation was invariably of the scalariform type, although not infrequently one of the two conjugation-processes arose from the apex of the end-cell of a thread (fig. 1, D, E). The material did not show the earliest stages in conjugation, but the processes are evidently rather short. As is characteristic for the genus, the fusing protoplasts meet in the canal (fig. 1, A) and a residuum of protoplasm remains in the conjugating cells. At this stage the conjugation canal is already markedly dilated and usually appears almost spherical (diam. about 26  $\mu$ ).

In the next stage the zygote becomes demarcated on either side from the conjugating cells by a thick, and often somewhat irregular, layer of a hyaline white substance (fig. 1, B, D, t) which, judging by the deep red tint assumed with ruthenium red, probably consists largely of pectic compounds. It does not stain with iodine, methylene blue or gentian violet. In a few instances this layer was seen to arise as an ingrowth from the membrane around the base of the conjugation papilla (fig. 1, C, M, t), but I do not believe that this is its customary method of formation.

<sup>1)</sup> The earlier papers in this series were published in the Journal of Botany (London), 1932-1942.

The available evidence suggests that it is usually deposited simultaneously across the whole width of the conjugation-process. These layers, which shut off the zygote from the parent cells, sometimes show a faint lamellation (fig. 1, B, D, H). Apparently, at the same time as the fused protoplasts are thus isolated from the conjugating cells, they secrete a first zygote-membrane around themselves. This appears to develop in the first place (fig. 1, C) over the portions of the zygote bounded by the conjugation-canal and only later to extend also over the surfaces adjacent to the pectic thickening-layers, although I am not convinced that this is invariably so. However that may be, it is clear that the outermost zygote-membrane, which appears to be partly pectic in nature, is in very close contact with the pectic thickening layers at either end of the conjugation-canal, and it is possible that these portions of the zygote-membrane are actually produced from parts of these layers adjacent to the fused protoplasts. A considerable number of the young zygospores are indented opposite the conjugation-papillae (fig. 1, B), but this is usually no longer recognisable in the mature condition when the faces adjacent to the conjugating cells are for the most part convexly rounded.

After the production of the primary zygospore-membrane there is appreciable enlargement of the zygote, but this ensues almost entirely in a plane parallel to the two conjugating cells so that by degrees the zygospore becomes markedly ellipsoidal in shape (fig. 1, D-F, I). As this happens, most of the outer part of the membrane of the conjugation-canal undergoes gelatinisation (fig. 1, B, E, H) or rupture, although the inner part remains for some time recognisable as a delicate layer around the enlarging zygote (fig. 1, F). The outer layer of the membrane of the conjugation-canal, however, persists as a collar at the base of each of the original papillae and appears in optical section as delicate projecting, and often recurved, strips flanking the irregular septum cutting off the zygospore from the parent-cells (fig. 1, D, F, G, I, s). It would seem that these septa often subsequently undergo considerable swelling so as to bulge out of the collars formed by the basal parts of the membranes of the conjugation processes and to become firmly pressed against the contiguous zygospore-membrane (fig. 1, G, I, p). Not uncommonly these projecting masses appear like conical stoppers, with the zygospore suspended between them, although this is by no means always so. It would seem that swelling of the thickening layers sometimes takes place at an earlier stage and causes the indentations of the young zygospores above referred to; even in some of the mature spores the surfaces in contact with these layers may be flattened or sometimes actually a little indented.

The mature zygospores are thus held between the two thickening layers, and it is evident that they are retained in this position for some time and with considerable firmness. No trace of the



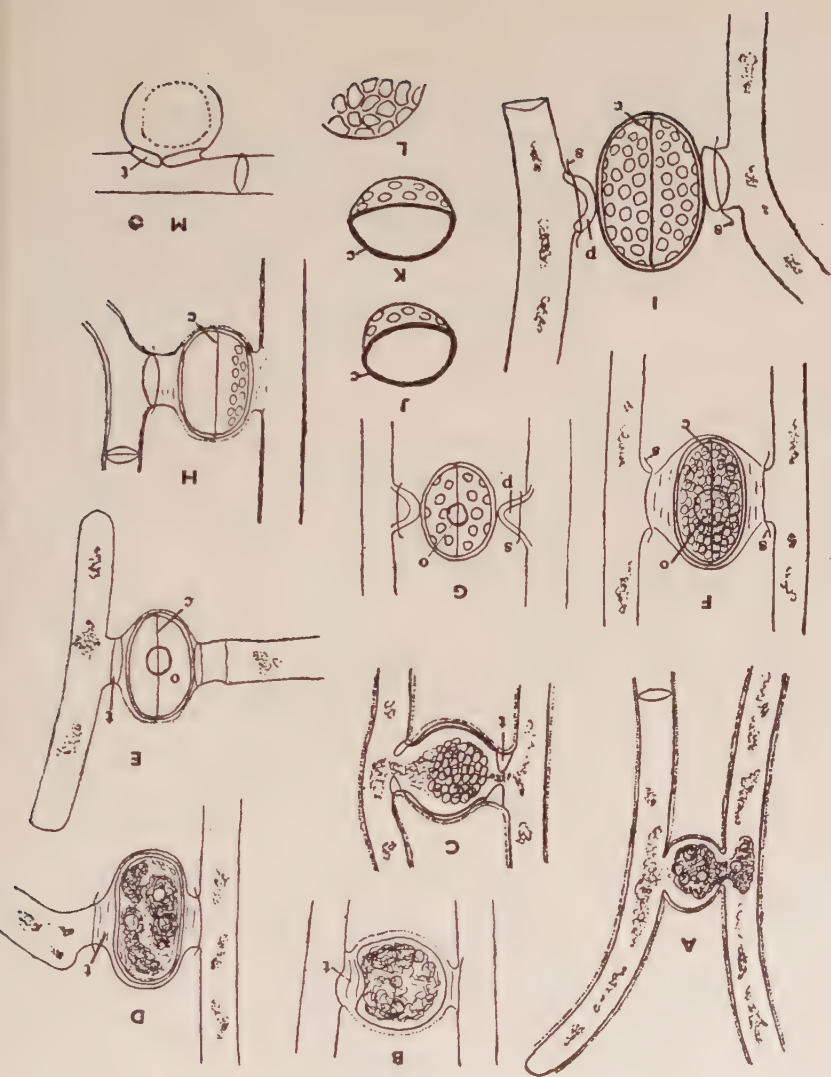


Fig. 1. *Mougeotia Smithii* n. sp. A, early stage in conjugation. B, H, young zygotes, prior to the complete dissolution of the conjugation canal. C, M, unusual mode of formation of the septa (t) demarcating the zygote. D, E, one of the two conjugating cells constituted by the end-cell of a thread. F, G, I, zygospores in various stages of development. J, K, half-mesospores from crushed zygospores. L, small part of surface of mesospore from a crushed zygospore. c, keel of zygospore; o, oil-globule; p, bulging septa at base of conjugation canal; s, remains of outer layer of conjugation canal; t, septa separating zygote from conjugating cells.  
(A-H, M X 400, I X 600, J, K X 500, L X 850).

inner layer of the membrane of the conjugation-canal remains over the greater part of the surface of the zygospore, which now appears to be in direct contact with the medium; there does not seem to be any appreciable mucilage-envelope. Though the zygospores appear elliptical in the position in which they are usually held between the remains of the conjugation-processes, they are seen to be circular when viewed from either side. In squashed preparations, in which the zygospores are dislodged, all of them appear rounded. In other words the shape of the zygospore is that of a spheroid, usually markedly flattened along an axis parallel to that of the conjugation-canal. Occasional zygospores approximate more to a true sphere. A series of typical dimensions are: 30 x 25; 30 x 26; 31 x 24; 31 x 29; 32 x 26; 34 x 26; 35 x 30; 36 x 29; 36 x 35  $\mu$ .

The membrane of the mature spores has the customary three layers. The exospore is smooth, colourless and rather thin. The mesospore is coarser, olive-brown in colour, and is provided with a prominent keel (fig. 1, E-1, c) which always runs in the direction of the long axis of the ellipse. In the intact zygospores the surface of the mesospore appears more or less clearly scrobiculate (fig. 1, G, I), although the depressions vary in shape and in their degree of proximity to one another. When the membranes are detached from the spores by crushing, the scrobiculations are often rather elusive and one sometimes gets the impression of a vague network of ridges following a somewhat irregular course (fig. 1, L). In such crushed spores the mesospore usually breaks into two halves along the line of the keel which appears as a narrow flange along each circular half-piece (fig. 1, J, K). The endospore is smooth, colourless and relatively thick. There is often a large and prominent fat-globule in the centre of the spore (fig. 1, E-G, o).

The alga above described shows several points of resemblance to Czurda's *M. oedogonioides* <sup>1)</sup> from Central Thibet. In both species the zygote becomes separated from the parent cells by gelatinous thickening layers, later projecting through the remains of the conjugation-processes which appear as collars around them; in both the zygospores remain suspended between the conjugating threads, while the mesospore of the ripe spore has a prominent keel running at right angles to the axis of the conjugation-tube and possesses a feebly developed pattern. There are, however, important differences. Thus, according to CZURDA, the thickening layers that separate the zygote from the conjugating cells always arise as thickenings of the membrane of the proximal parts of the conjugation-processes. Moreover, the mature zygospores seem to be spherical and are surrounded by a wide hyaline mucilage-envelope (cf. *M. gelatinosa*), which in *M. oedogonioides* is pro-

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<sup>1)</sup> Beih. Bot. Centralbl., 48, Abt. II, 1931, p. 286.



bably mainly instrumental in retaining the spore *in situ*. This species also shows copious lateral conjugation which takes place through the end-walls of adjacent cells, much as in *Spirogyra colligata* Hodgetts <sup>1)</sup>).

There is also some resemblance to *M. adnata* Iyengar, <sup>2)</sup> where the maturing zygotes are cut off from the conjugating cells by a thick refractive layer with which the ripe zygospores are in close contact, while the conjugation-tube gelatinises except for the portions immediately adjoining the conjugating cells. The conjugation is here mainly lateral. The zygospores are ellipsoidal or sometimes reniform and the mesospore is smooth and devoid of a keel. The colour in *M. oedogonioides* is yellow, in *M. adnata* dark brown.

It is evident that there is a tendency in certain species of *Mougeotia* to demarcate the zygote from the parent-cells by the deposition of a thick hyaline layer of membrane material, although in most instances no data are available as to its nature and mode of formation. Examples are seen in *M. bicalyptata* Wittr. <sup>3)</sup>, *M. Maltae* Skuja <sup>4)</sup>, *M. jogensis* Iyengar <sup>5)</sup> (where it arises in the same way as in *M. oedogonioides*), and in diverse of the species with quadrate zygospores. The condition met with in *M. oedogonioides* and *M. Smithii* is possibly a further outcome of this tendency. On the other hand, this feature also suggests a comparison with the species referred to the genus *Debarya*, where very extensive deposits of a similar kind are formed throughout the conjugating cells, as the gametes pass into the canal.

The diagnosis of the new species is as follows:— *Mougeotia Smithii* n. sp. *M. cellulis* 13—17  $\mu$  latis, 6—18 plo longioribus quam latis, conjugatione scalariformi, cellulis conjugatis plus minusve genuflexis. Zygosporis inter cellulas conjugatas suspensis, partes basales processuum conjugationium adhaerentibus, sphaeroideis (vulgo evidenter depresso-globosis), in aspectu normali ellipticis, in planitie perpendiculari circularibus, exosporio tenui hyalino, mesosporio carinato, ex duas partes constanti, leviter scrobiculato; sporis 30—36  $\mu$  longis, 25—35  $\mu$  latis.

Hab. in cataractis inferioribus, Aysgarth, Yorkshire, England.

## X. Notes on new or seldom reported British Algae.

1. The genus *Nannochloris*. There are no doubt a considerable number of coccoid Algae of very small dimensions, which in nature rarely occur in sufficient quantity to make themselves noticeable. Every one who is accustomed to look through gather-

<sup>1)</sup> Ann. of Bot., 34, 1920, p. 519.

<sup>2)</sup> Rev. Algol., 6, 1932, p. 270.

<sup>3)</sup> Bot. Notiser, 1886, p. 136.

<sup>4)</sup> Act. Hort. Bot. Univ. Latviensis, 1, 1926, p. 111.

<sup>5)</sup> loc. cit., p. 268.

ings of freshwater Algae will be familiar with such forms. They only come to the front when, for some reason, competition with other forms is reduced, and in particular they tend to occur in artificial waters supplied with additional nutriment in one form or another. Here they may appear in countless numbers as an almost pure culture and impart to the water a green tint of varying depth. Two organisms of this type were described by NAUMANN <sup>1)</sup> in 1919 as species of a new genus *Nannochloris*; they appeared in waters supplied with artificial manures. The genus is characterised, according to NAUMANN, by having cells with a single parietal chloroplast and a hyaline cell-wall, as well as by multiplication occurring by direct transverse division of the cell. *N. bacillaris* with rod-shaped cells attains a length of  $3.5\ \mu$ , *N. coccoides* with spherical cells a diameter of  $2.5\ \mu$  prior to division.

An alga, which is undoubtedly a species of *Nannochloris*, if not identical with *N. coccoides*, was described by PENNINGTON <sup>2)</sup> under the name of *Diogenes rotundus* from material that appeared in a tub in the University of Reading Botanic Garden; the water was a rich culture solution containing nitrate of ammonia. The only noteworthy difference from *N. coccoides* Nau- ( $1.5\text{--}2\ \mu$ ). NAUMANN was not a taxonomist, and it is possible that he spherical cells, although these show somewhat smaller dimensions ( $1.5\text{--}2\ \mu$ ). NAUMANN was not a taxonist, and it is possible that he failed to search for a pyrenoid which might readily be overlooked in view of the minute dimensions of the cells. For the present, however, PENNINGTON's form had best be regarded as a separate species, *Nannochloris rotundus*.

I have seen occasional samples of Algae resembling those under discussion, without examining them in detail. The only apparent line of separation between these forms and *Chlorella* lies in the method of multiplication, which requires further investigation. PENNINGTON's description of cell-division as "following the appearance of a constriction across the middle of the cell" is more suggestive of the division of a protoplast, and it is possible that suitable stains would disclose an enveloping membrane.

Many years ago Prof. BROOKS sent me a minute form that appeared in great profusion in an aquarium of the Botany School, Cambridge, colouring the water a yellowish green; of this I still have some preserved material. The bulk of the spherical cells are less than  $1\ \mu$  in diameter. Although, in preparations stained with methylene blue, some indications of internal differentiation in the form of a more deeply staining body are occasionally recognisable, I am not prepared to assert that there is a definite chloroplast. Apart from occurring singly, the cells are very commonly found in pairs (fig. 2, O). The protoplasts of the two cells

<sup>1)</sup> Arkiv f. Bot., 16, No. 2, 1919, p. 16.

<sup>2)</sup> Journ. of Bot., 79, 1941, p. 83.



are then not usually contiguous, but separated by a rather thick homogeneous layer (fig. 2, M) which stains faintly with methylene blue. Occasionally cells occur in groups of fours in one plane and tetrad-like groupings are also present (fig. 2, N). Sometimes, too, the cells are found cohering in short, often curved, rows of 3 or 4 cells. Fig. 2, O reproduces a drawing made by Miss F. RICH from living material. There are indications that the outer surface of the cell-membrane may be somewhat mucilaginous. It is possible that this alga is one of the Cyanochloridaceae (Chlorobacteriaceae)<sup>1)</sup>, but the material is now so old that it may no longer preserve its normal condition.

Similar minute green forms occur in the sea, although some of these are probably species of *Coccomyxa* (cf. *C. litoralis* (Hansg.) Wille<sup>2)</sup>).

2. *Prasinocladus lubricus* Kuck. In Newton's "Handbook of British Seaweeds" (p. 54) this alga is recorded as: very rare; Plymouth. It seems probable, however, that its rarity is only apparent, since the colonies that it forms are of small dimensions and might readily be overlooked. It occurs occasionally as relatively pure growths in marine aquaria which, since the source of the water in this country is usually Plymouth, would not afford evidence of a wider distribution. In August, 1942, however, Dr. S. P. CHU obtained typical growths of *P. lubricus* growing on *Ectocarpus* at Millport, Scotland, implying a much further extension northwards in the British Isles. I also obtained material from a bathing-pool at Blackpool, Lancs. in September, 1943. The alga has been recorded from the Trondhjemfjord by PRINTZ<sup>3)</sup>.

In aquaria much of the growth seems to be of the stunted type shown in KUCKUCK's original figures<sup>4)</sup>, some of which are reproduced by NEWTON. KUCKUCK found his form in cultures that were stated to be in an unhealthy condition. The Millport material, on the other hand, resembles that described by DAVIS<sup>5)</sup> as *Euglenopsis* and renamed *Chlorodendron* by SENN<sup>6)</sup>. ZIMMERMANN<sup>7)</sup> subsequently showed that this is probably the normal state of development of a *Prasinocladus*-like form. As DAVIS recognised, the elongate and occasionally branched colourless stalks, that appear irregularly septate (cf. fig. 2, A, D) and bear the green cells of the alga, are empty cell-walls formerly occupied by the

<sup>1)</sup> L. Geitler & A. Pascher, Süsswasserfl. Deutschlands, etc., 12, 1925, p. 451.

<sup>2)</sup> N. Wille, K. Norsk. Vidensk. Selsk. Skrift., Trondhjem, 1906, No. 3, p. 26.

<sup>3)</sup> Skrift. Norsk. Vidensk.-Akad. Oslo, I, Mat.-Nat. Kl., No. 5, 1926, p. 214.

<sup>4)</sup> Wiss. Meeresunters., Helgoland, N. F., 1, 1894, p. 262.

<sup>5)</sup> Ann. of Bot., 8, 1894, p. 377.

<sup>6)</sup> Flagellata, in "Natürl. Pflanzenfam.", I, 1a, 1900, p. 187.

<sup>7)</sup> Wiss. Meeresunters., Helgoland, 16, 1924, p. 11.

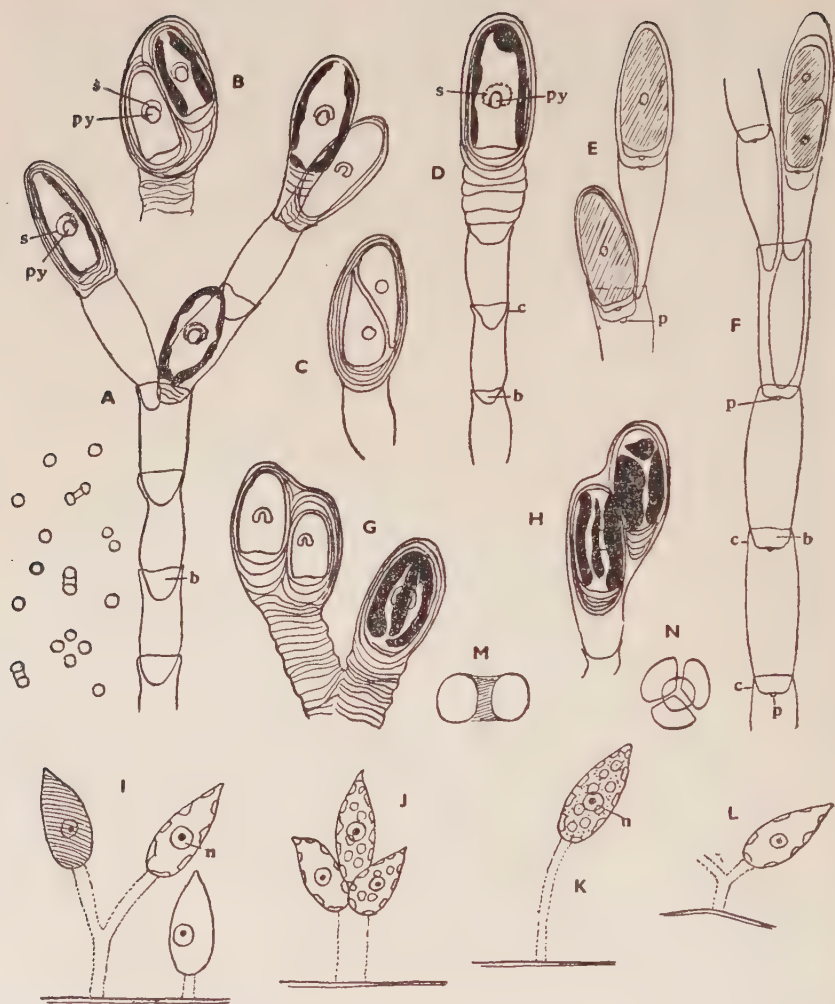


Fig. 2. A-H, *Prasinocladus lubricus* Kuck., E-F from Millport, the rest from aquarium-material. A, branching colony, with elongate stalks; B, G, the stunted growth-form, typical of aquarium-material; C, cell-division; D, cell at end of an elongate stalk which has finally undergone repeated rejuvenation; E, branching; F, part of a normal colony; H, cell-division. b, base of empty cell-membrane; c, collar formed by upper part of cell-membrane of previous generation; p, papilla; py, pyrenoid; s, starch-sheath. I-L, *Colacium epiphyticum* n. sp. n, nucleus. M-O, *Nannochloris* sp. (?); O (drawing by Miss F. Rich) shows distribution of cells in living material.

(A-D, G, H X 1000, E, F X 750, I-L X 550, M, N (diagr.) X 500, O X 1400.)



individual cell borne at the apex of the stalk. The latter is in fact formed by repeated rejuvenation of the protoplast, involving each time the secretion of an entirely new membrane, the rupture of the previous membrane at the apex, and the upward passage of the rejuvenated cell to a more or less considerable extent until its base (fig. 2, D, F, b) is only enclosed in a collar-like strip (c) of the previous cell-wall.

Under certain conditions, which seem to obtain *inter alia* in aquaria, the processes of rejuvenation occur with great frequency and each new generation only shifts a very short distance upwards. As a result the cells appear at the ends of short, transversely lamellated stalks (fig. 2, G), which led KUCKUCK to misinterpret them as mucilage-stalks. Such stunted growth-forms are, however, in the aquarium-material I have examined <sup>1)</sup>, always accompanied by occasional colonies with elongated stalks resembling those described by DAVIS (fig. 2, A, D), and the investigation of such material leaves no doubts as to the correctness of ZIMMERMANN's conclusion. Even in these more elongate colonies, however, rejuvenation may sometimes in aquarium material take place at rather frequent intervals so that the apparent "septa" may in places be closely crowded in the stalks (fig. 2, D). Another feature characteristic of this growth-form are the thick and stratified membranes enveloping the actual individuals (fig. 2, B-D, G).

Much of the Millport material consists of long sparsely branched stalks in which the rejuvenated cell has passed up almost to the aperture of the membrane of the previous generation (fig. 2, F) so that the segments of the stalks are all of approximately equal length; there may be 28 or more such segments in one of these long stalks. The septa marking the lower boundary of any given generation show a distinct median papilla (fig. 2, E, F, p) which, according to LAMBERT <sup>2)</sup>, bears four flagella at each process of rejuvenation, although these are soon withdrawn. DAVIS' figures show nothing of this. In the aquarium material also such papillae are rarely recognisable, the lower end of the cell being more or less rounded (fig. 2, A, D). This may be the result of imperfect preservation, since the material in question was fixed many years ago, but it may also mean that the flagellate stage is suppressed during the repeated rejuvenation in the aquarium material. The empty cell-walls forming the stalks invariably stain readily with methylene blue or ruthenium red.

The chloroplast is markedly dissected (fig. 2, G, H), but could not be adequately deciphered in the material available. The pyrenoid usually lies near the middle of the cell and is a polar one <sup>3)</sup>

<sup>1)</sup> From a marine tank in the Department of Zoology, University College, London, supplied with sea-water from near the Eddystone Lighthouse.

<sup>2)</sup> Zeitschr. f. Bot., 23, 1930, p. 239.

<sup>3)</sup> Fritsch, Structure and Reproduction of the Algae, I, 1935, p. 68.

(fig. 2, A, B, D, py), since the starch-sheath(s) is developed only on the posterior side, i.e. the side which faces the apex of the colony. The pyrenoid stains conspicuously with cotton blue in lacto-phenol, the starch-sheath then appearing as a clear space extending round a considerable part of the circumference laterally and posteriorly. The pyrenoid was interpreted as a nucleus by KUCKUCK and DAVIS, and this error is repeated by NEWTON. According to ZIMMERMAN the actual nucleus is small and lies in front of the pyrenoid. I am not altogether convinced that the starch-sheaths of the pyrenoids always possess this characteristic shape. Not uncommonly they appeared to extend all round the pyrenoid. The eye-spot was only recognisable in the Millport material. Division of the cells is always markedly oblique (fig. 2, B, C, F) and as a general rule results in branching (fig. 2, A, E, H).

The cells of the Millport colonies were in general appreciably longer ( $20-25\ \mu$ ) than those of the aquarium material ( $11-12\ \mu$ ), though occasional more elongate cells were observed in the latter; the breadth ( $7-8.5\ \mu$ ) was much the same in both. The Millport colonies were also characterised by possessing rather broader stalks (diam.,  $5-7\ \mu$ ); those of the aquarium material were for the most part only  $4\ \mu$  wide, although some reached a width of  $6\ \mu$ . These differences, taken together with the variable development of papillae (cf. above), suggest the possibility of more than one species being involved, but they may equally well be the result of habitat-differences.

3. *Colacium epiphyticum* n. sp. Cellulis ovoideis, basi rotundata, apice acuminato saepe cum apiculo hyalino; stipite pellucido tenui plus minus elongato simplici vel dichotomo, rarius plus ramoso, algas diversas affixo; chomatophoris parietalibus discoideis numerosis, nucleo conspicuo globoso in parte centrali cellulae; periplasto tenui delicate striato. Long. cell.,  $22-28\ \mu$ ; lat.,  $8-10.5\ \mu$ .

Hab. Restbury, Cheshire.

Species of the genus *Colacium* are usually found epizoic on planktonic Crustacea and Rotifers, although LEMMERMANN <sup>1)</sup> mentions occurrence on filamentous Algae without its being clear whether the remark refers to *Colacium* or *Ascoglena*. The species here described was found by Mr. H. E. LEES in August, 1933 in a pool at Restbury, Cheshire attached to filaments of *Vaucheria* and *Oedogonium*. The individuals are borne on slender, pellucid mucilage-stalks which are of variable length and either simple (fig. 2, I, K) or commonly forked (fig. 2, I, L); only one colony affording indication of further branching was observed (fig. 2, J). The individual cells are ovoid in form with the greatest width

<sup>1)</sup> Süßwasserfl. Deutschlands, etc., 2, 1913, p. 120.



at about  $1\frac{1}{3}$ rd of the length from the rounded base. The apex (actually the posterior end in the motile phase) is pointed and usually drawn out into a very short colourless process, sometimes bent a little to one side (fig. 2, J). The numerous parietal chloroplasts take the form of flattened discs which are often somewhat irregular in outline, while the large spherical nucleus (diam. up to  $5\ \mu$ ) with a prominent nucleolus, so characteristic of *Euglenineae*, lies near the centre of the cell. The paramylon-grains are small and appear in part to be apposed to the inner surface of the chloroplasts, although I am not able to speak with certainty on this point. In individuals stained with gentian violet, numerous small granules were evident in the peripheral cytoplasm (fig. 2, K); these may consist of paramylon. An eye-spot was not observed. The periplast is very thin, although there was little evidence of metaboly. It is very delicately striated, the striations either running almost transversely (fig. 2, I) or inclining to a longitudinal direction. It is possible that there are two sets of striations, but the material is inadequate to settle this point. I obtained no evidence of the presence of a mucilage-envelope around the cell.

Apart from its epiphytic mode of life, this species differs altogether in the shape of its cells from the three enumerated by LEMMERMANN (loc. cit., p. 155). The forked slender stalks and the probable absence of a mucilage-envelope around the cell are other points of contrast.

A similar form, epiphytic on *Oedogonium*, *Mougeotia*, *Vaucheria*, and *Synedra*, was observed in frosty weather in a pool in Clissold Park, North London in December, 1943 by Dr. HILDA CANTER, to whom I am indebted for the following particulars. The individual cells were of the same shape, but in general rather larger, being  $25\cdot4$ – $43\ \mu$  long and  $10$ – $13\cdot9\ \mu$  broad. A red stigma was recognised to one side of the gullet, which measured  $10\cdot5$ – $12\cdot4\ \mu$  long and  $4\cdot3$ – $5\cdot7\ \mu$  wide. The numerous chloroplasts were distinctly lobed and were provided with pyrenoids with a double sheath. The numerous paramylon grains were small, spherical to oval in shape. Only further investigation can show whether this is a larger form of the Cheshire alga or whether it represents a distinct species. The material, upon which I have based my description of the Cheshire form, was not sufficiently well preserved to enable me to say whether the chloroplasts had pyrenoids or not.

# Deux espèces de *Vorticella* commensales des *Conochilus*

par

E. FAURÉ-FREMIET (Paris)

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A. C. STOKES (1889) a constaté la présence, sur les colonies de *Conochilus volvox* trouvées dans les eaux douces américaines, de deux espèces de Vorticellides commensales qu'il a décrit sous le nom de *Vorticella conochili* et de *V. conosoma*.

J'ai retrouvé ces mêmes espèces, parfaitement caractérisées, dans les colonies de *Conochilus unicornis* Rousselet <sup>1)</sup>, qui ont envahi, pendant quelques jours, au début de mai, le plankton du lac du Bois de Boulogne (fig. 1); elles présentent l'une et l'autre, des caractères d'adaptation à leur hôte qui méritent d'être examinés de plus près.

## VORTICELLA CONOCHILI STOKES.

Par sa forme campanulée et légèrement allongée (fig. 2), cette espèce ressemble beaucoup à *V. microstoma*; son corps mesure, en extension 40 à 50  $\mu$  de hauteur, et semble un peu plus grand que celui de la forme américaine (soit environ 34  $\mu$  d'après STOKES). La collerette forme un mince bourrelet annulaire; le disque est aplati; la vésicule contractile, simple, est située audessous du vestibule; le macronucleus, en forme de ruban court et épais, se contourne dans un plan transversal, autour du vestibule et du pharynx, dans la région antérieure du corps. Le pellicule superficielle porte de fines stries transversales, très rapprochées.

La particularité de cette espèce est dans la structure de son pédoncule, très exactement notée par STOKES. Ce pédoncule, ou style, long et rectiligne, plonge dans la masse mucilagineuse transparente qui enrobe les *Conochilus* disposés eux-mêmes en colonies rayonnantes.

Tandis que chez presque toutes les espèces du genre *Vorticella* le „cordon central” et sa fibre myoïde occupent toute la longueur du pédoncule dont la gaine porte un épaississement spiral formant ressort (E. FAURÉ-FREMIET 1905), on observe chez *V. conochili* une structure simplifiée de cet appareil de fixation. Le „cordon

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<sup>1)</sup> Cette espèce a été déterminé par mon collègue et ami P. DE BEAUCHAMP.



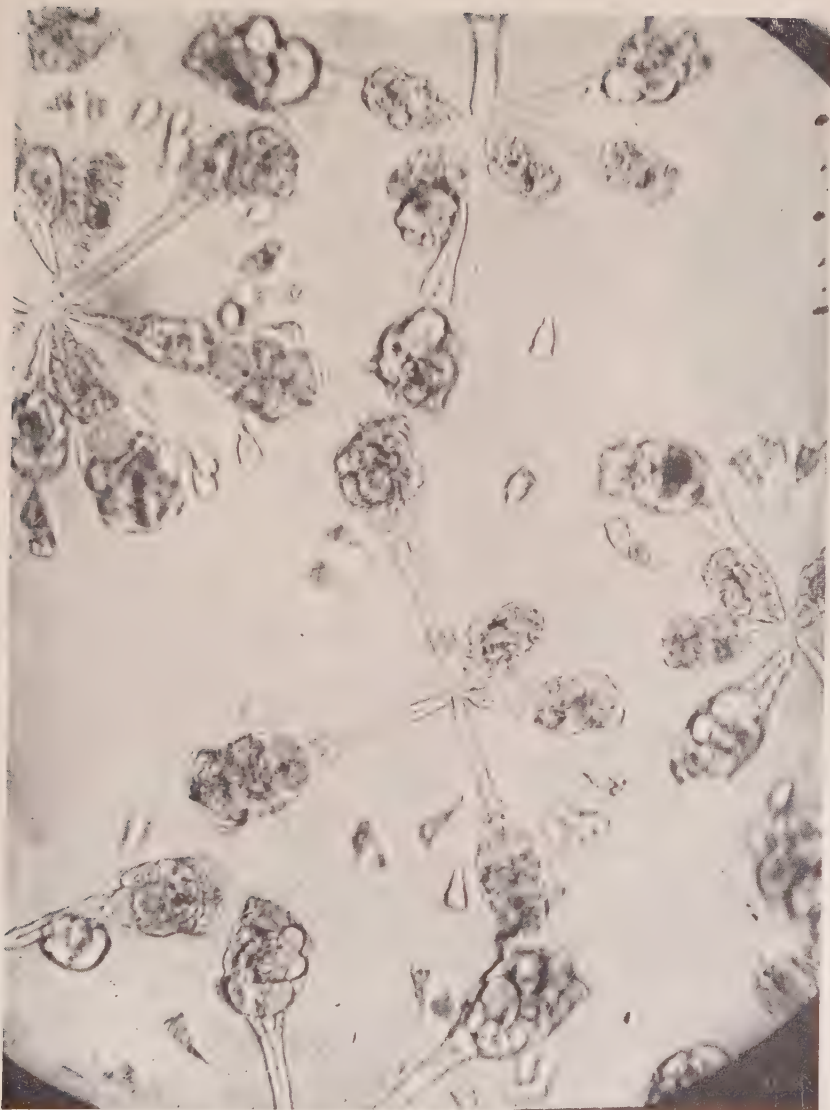


Fig. 1. — Colonies de *Conochilus unicornis* avec les Vorticelles commensales.  
Microphotographie instantanée L'échelle représente 200  $\mu$





central" et la fibre myoïde qui prolongent le corps de l'Infusoire occupent seulement, sur une longueur de 40  $\mu$  environ, la partie antérieure, cylindrique, du style, qui se prolonge assez loin au-delà sous forme d'une tige rigide légèrement et progressivement amincie vers son extrémité distale.

Au cours de la contraction, la fibre myoïde se raccourcit de près de moitié; comme l'a bien observé STOKES, cette contraction est rectiligne et entraîne le plissement transversal irrégulier de la gaine externe (fig. 3) au lieu de la spiralisation régulière imposée par le ressort hélicoïde des Vorticellides du type normal. De ce fait l'amplitude du mouvement général de rétraction est très faible puisqu'il est exactement réduit à l'amplitude de la contraction de la fibre myoïde, soit à environ 18 à 20  $\mu$ .

*V. conochili* se divise suivant le mode ordinaire en formant un individu migrateur pourvu d'une ceinture ciliaire antapicale; les individus fixés peuvent, eux aussi, se transformer en migrateurs et quitter leur style, de sorte qu'il n'est pas rare d'observer, sur les colonies de *Conochilus* conservées *in vitro*, des pédoncules résiduels.

Ajoutons encore que, dans les conditions de conservation et d'observation *in vitro*, on observe fréquemment l'enkystement des individus migrateurs.

## VORTICELLA CONOSOMA STOKES.

*V. conosoma* se distingue au premier abord de *V. conochili* par sa forme très allongée (fig. 4); mais seule une observation plus attentive révèle les différences essentielles qui justifient sa description comme espèce distincte, telle que l'a proposé STOKES.

Comme l'écrit très exactement cet auteur, le corps de *V. conosoma*, long de 60 à 70  $\mu$  en extension, apparaît „conique, souple et flexible, transversalement strié, environ quatre fois plus long que large; il s'évase largement au niveau de la collerette pour s'amincir progressivement ensuite jusqu'à l'origine du pédoncule”.

Le disque est moins large et plus nettement marqué que chez *V. conochili*. La vésicule contractile, simple, est située au-dessous du vestibule. Le macronucleus, en forme de ruban épais et court se contourne obliquement autour du pharynx dans la région antérieure du corps. La pellicule porte des stries transversales très fines, et espacées.

Le style, rectiligne, très étroit, s'amincit progressivement vers son extrémité distale; il contient, dans sa partie antérieure, un mince prolongement du corps, long de 25  $\mu$  environ, correspondant au „cordon central” mais totalement dépourvu de contractilité, ce que STOKES semble bien avoir déjà reconnu. En fait le dispositif contractile est, chez cette espèce, l'apanage exclusif des myoïdes du corps proprement dits; mais ceux-ci forment un système fibrillaire très fortement développé, qui apparaît, chez

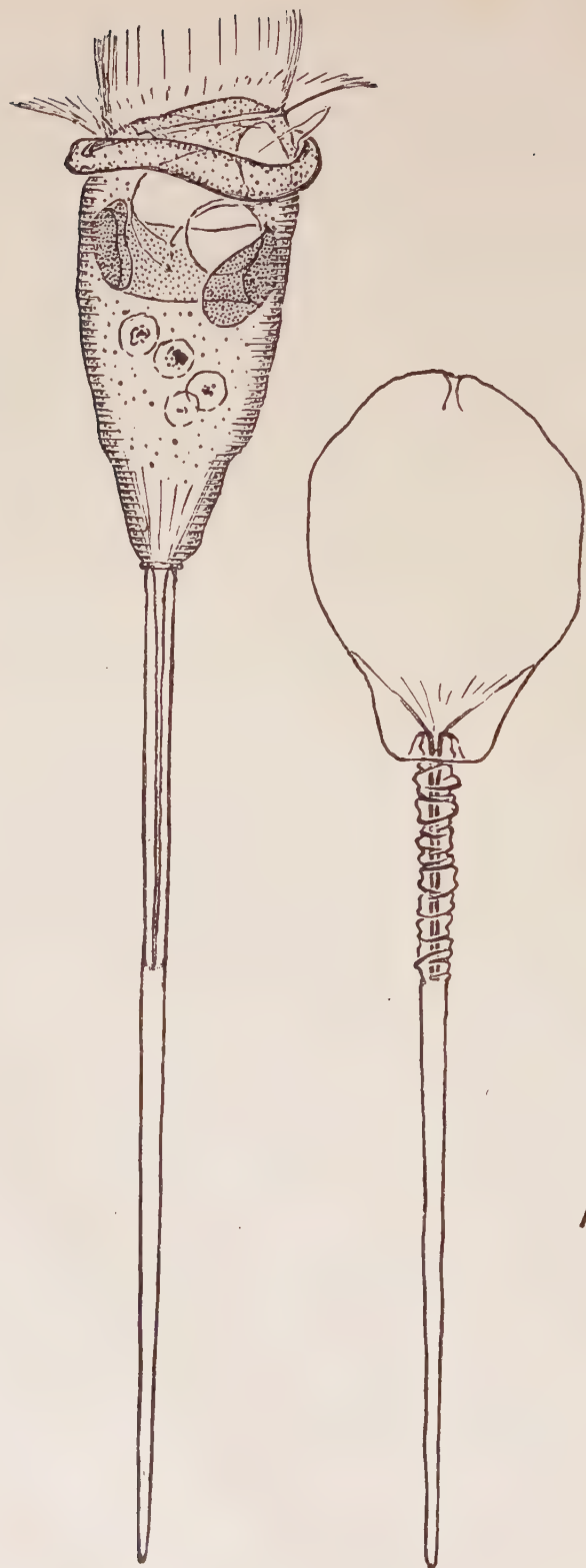


Fig. 2. — *Vorticella conochili* en extension.  
 Fig. 3. — La même à l'état contracté; la structure interne n'est pas figurée; remarquer la contraction du corps et celle de la fibre myoïde, qui entraîne le plissement irrégulier de la gaine pédonculaire.



l'Infusoire vivant, comme un cône réfringent très allongé, dont la pointe est fixée distalement sur l'origine du pédoncule et dont la base s'étale sur la surface ectoplasmique, avec laquelle elle se confond, dans le tiers antérieur du corps.

Au cours de la contraction, toute la région antérieure du corps forme une masse ovoïde, limitée postérieurement par un repli au delà duquel la pellicule se plisse irrégulièrement autour du cône myoïde raccourci de près de moitié (fig. 5). Le dispositif contractile est donc nettement épistylaire, le pédoncule ne jouant plus d'autre rôle que celui de support inerte.

Une telle différenciation du cône myoïde postérieur, ou épistylaire, n'est pas nouvelle; elle a été décrite par B. COLLIN (1909) chez *Operculania faurei*; elle caractérise certaines formes fixées mais dépourvues de style, telle que *Scyphidia terebellae* FAURÉ-FREMIET (1920), pour lesquelles KAHL a créé le genre *Paravorticella*.

Comme *Vorticella conochili*, *V. conosoma* forme des individus migrants du type normal et ceux-ci peuvent s'enkyster.

## LE CAS DE VORTICELLA DIMORPHA STILLER.

J. STILLER (1940), observant au mois de septembre, de très nombreuses colonies de *Conochilus unicornis* dans le plankton du grand lac de Plön, trouve associée à celles-ci une Vorticelle commensale de petite taille, soit 32-35  $\mu$  en extension, qui diffère indiscutablement des deux espèces de STOKES, non seulement par son aspect général, mais encore et surtout par un caractère constant, la présence de deux vacuoles contractiles.

Il est curieux de constater que cette espèce se présente sous deux aspects différents, d'où le nom de *V. dimorpha* St.; certains individus sont de forme globuleuse, épaisse, tandis que d'autres sont de forme conique, élancée, et STILLER pose la question de savoir si ces deux formes sont en rapport avec le cycle de reproduction, comme chez les *Zoothamnium* dimorphes, par ex. De toute manière, la forme conique ne paraît pas comparable à *V. conosoma*; notablement plus petite, elle ne semble pas présenter la différenciation myoïde épistylaire qui caractérise celle-ci.

Il apparaît ainsi que l'espèce du lac de Plön est une troisième Vorticellide adaptée au commensalisme avec les colonies de *Conochilus*, car le fait de retrouver à Paris, dans le lac du Bois de Boulogne, les deux formes observées en Amérique par STOKES soixante ans plus tôt, laisse supposer que les *V. conochili* et *conosoma* sont des espèces à caractère nettement fixés, et non des variétés locales.

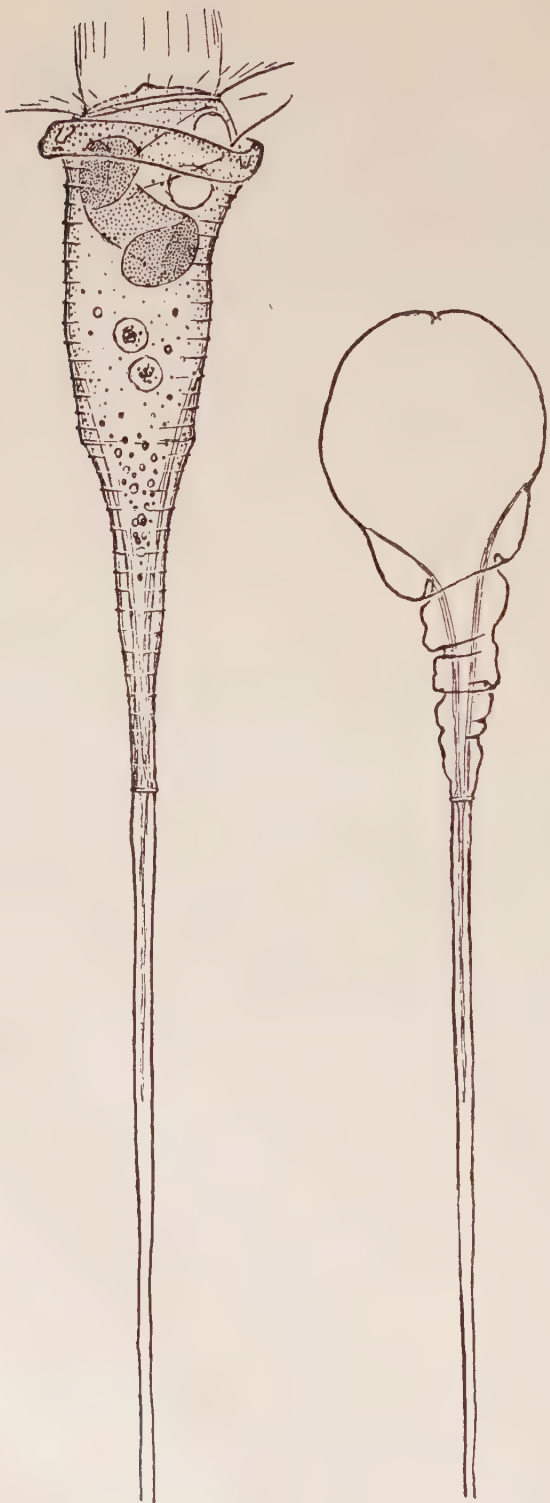


Fig. 4. — *Vorticella conosoma* en extension.

Fig. 5. — La même à l'état contracté; la longueur du pédoncule ne change pas; le raccourcissement dû à la contraction du cône myoïde porte exclusivement sur la partie postérieure du corps qui se plisse irrégulièrement.



## LES CARACTERES ADAPTATIFS DES VORTICELLA CONOCHILI ET CONOSOMA.

Les deux espèces précédemment décrites apparaissent, physiologiquement, comme des Vorticelles planktoniques et probablement catharobes, vivant dans un milieu liquide aéré, étendu, continuellement renouvelé par la natation des colonies de *Conochilus* auxquelles elles se trouvent associées; ce mode de vie est physiologiquement comparable à celui du *Carchesium limneticum* Svec, par exemple (voir E. FAURÉ-FREMIET, 1948), qui a reparu dans le plankton du lac du Bois de Boulogne en même temps que *Conochilus unicornis*, mais qui vit librement, et dont les colonies essaïmantes se meuvent par elles-mêmes.

En même temps, les deux *Vorticella conochili* et *conosoma* se comportent de par leur habitat comme des Infusoires loriquées qui se rétractent dans une logette protectrice à la moindre alerte. La comparaison la plus exacte est donnée par les *Ophrydium*, mais ces Vorticellides étalent en extension leur peristome au dessus d'une masse mucilagineuse qui les enrobe et qu'elles sécrètent elles même, tandis que les deux Vorticelles commensales utilisent la gelée formée par les *Chonochilus* auxquels elles s'associent.

Si la contraction et la rétraction du pédoncule, qui éloigne brusquement l'Infusoire d'un contact insolide, peut être considérée comme un moyen de défense, il est évident que la présence d'une enveloppe protectrice, logette ou gelée, diminue la valeur effective de l'amplitude du mouvement de rétraction. En fait, les Vorticellides loriquées: *Vaginicola*, *Cothurnia*, *Ophrydium*, ne possèdent pas de pédicule contractile, mais leur corps est capable de s'allonger considérablement en extension et de se raccourcir brusquement par contraction.

Les deux espèces de STOKES appartiennent indubitablement au genre *Vorticella* et se rapprochent morphologiquement de formes telles que *V. microstoma*; leur adaptation au milieu mucoïde étranger qu'elles habitent est réalisée par deux moyens différents, avec ce caractère commun à l'un et l'autre cas, que la structure normale du pédicule vorticellien accuse une sorte de régression simplificatrice telle que dans l'un et l'autre cas, l'amplitude du mouvement de rétraction est notablement réduite et permet seulement à l'Infusoire de disparaître au dessous du niveau superficiel de la masse mucoïde.

Chez *V. conochili* la simplification du style se manifeste par la suppression de l'épaississement spiral de la gaine externe; par l'existence d'une longue partie basilaire (c'est-à-dire distale) pleine et non contractile, telle un pédoncule d'*Epistylis* mince et long; par la réduction correspondante en longueur du cordon central contractile. La fine gaine externe qui, dans la partie proximale, entoure le cordon contractile, reste élastique, comme le

montre son dépliement après la contraction ; mais cette élasticité est également répartie sur toute la surface.

En langage anthropomorphique, on pourrait dire que cet Infusoire fait l'économie d'une structure profondément anisotrope et dissymétrique devenue inutile ; mais il est possible, d'autre part qu'une telle structure soit nuisible en imposant, dans ce cas, un mode de rétraction dont l'amplitude et l'enroulement spiral sont incompatibles avec la résistance opposée par la masse gélifiée enrobante <sup>1)</sup>.

Chez *V. conosoma*, la solution adoptée est différente et rappelle le cas des *Ophrydium* en ce sens que le pédoncule ne joue plus guère d'autre rôle que celui d'un organe fixateur, tandis que l'élongabilité et la contractilité du corps se trouvent accrues par la différenciation inusuelle du cône myoïde épistylaire.

## RÉSUMÉ.

Deux espèces du genre *Vorticella*, commensales des colonies de *Conochilus*: *V. conochili* et *V. conosoma* Stokes (1889), sont retrouvées aux environs de Paris.

Ces deux espèces sont bien caractérisées et sont différentes de *V. dimorpha* Stiller.

L'adaptation de l'une et de l'autre à leur habitat muqueux est caractérisée par l'amplitude réduite de leur mouvement de rétraction.

Ce résultat est obtenu par des moyens différents chez l'une et chez l'autre de ces deux espèces.

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<sup>1)</sup> Chez *Vorticella Mayeri* (E. FAURE-FREMIET, 1920) l'épaississement de la gaine pédonculaire formant ressort persiste, mais il est longitudinal et non plus spiral il en résulte que le pédoncule se recourbe brusquement pendant la contraction, et fonctionne en quelque sorte à la manière d'un flagellum.

# Beiträge zur Kenntniss der Algenflora des Kantons Zürich

## VI. Die Algenflora des Werrikerriedes E des Greifensees

Von

EDWIN MESSIKOMMER

Seegräben (Kanton Zürich)

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### EINLEITENDE BEMERKUNGEN

Die Riedlandschaften im Glattalabschnitt Uster-Oerlikon, die einst für das mittlere Glattal so bezeichnend waren, sind durch Kultureingriffe, besonders während der Anbauperioden der beiden Weltkriege, stark dezimiert worden. Zu den bis auf den heutigen Tag verschont und erhalten gebliebenen Sümpfen und Riedern gehören noch: das Werrikerried, das Schwerzenbacherried N des Greifensees, das Krutzelried bei Gfenn-Dübendorf und der Riedsumpf SE des Weilers Hof bei Wallisellen. Es besteht die Gefahr, dass auch diese letzten Reste eines urtümlichen Landschaftselements von der Bildfläche verschwinden. Wie Erkundigungen an zuständiger Stelle ergeben haben, sind für die Entsumpfung des Werrikerriedes bereits die nötigen Pläne und



Kostenberechnungen angefertigt worden. Die interessierten Anwohner begrüßen aus wirtschaftlichen und hygienischen Gründen das projektierte Meliorationswerk. Weniger erbaut darob sind die Verfechter und Befürworter des Natur- und Heimatschutzgedankens, denen die Erhaltung eines herkömmlichen Landschaftsbildes am Herzen gelegen ist. Wenn auch heutzutage bei den Meliorationsmassnahmen mit mehr Verständnis vorgegangen wird, als vor Jahren, so wird doch durch den Eingriff das Landschaftbild und die dem Gebiete zugehörige Organismenwelt erheblich verändert. Pfützen, Altwasserläufe, Torfbildung hören auf zu existieren und die an die betreffenden Standortsverhältnisse angepasste Flora und Fauna muss den Rückzug antreten. Das Landschaftbild verliert dabei an Farbe, Mannigfaltigkeit und Ursprünglichkeit. An Stelle der historisch bedingten Landschaftselemente tritt die monotone Kulturlandschaft. Die bewirkten Verschiebungen beschränken sich nicht allein auf die makroskopische Erscheinungswelt, sondern erstrecken sich auch auf die mikroskopischen Dimensionen. Mit der Entsumpfung des Werrikerriedes würde zum Beispiel eine äusserst reichhaltige Algenflora zugrunde gerichtet, sofern nicht durch Offenhalten von Entwässerungsgräben einem gewissen Teile wenigstens die Fortexistenz gestattet bliebe.

## I. DAS GEBIET

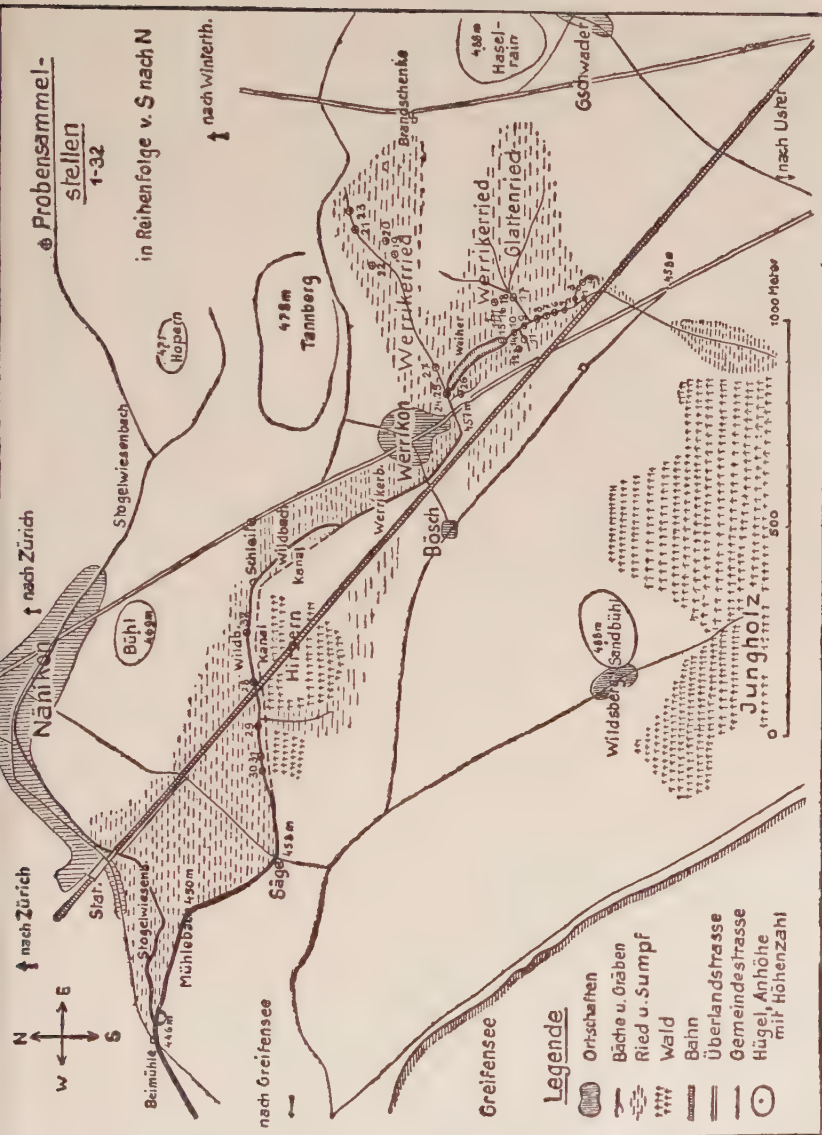
### 1. Geographie

Die Erdlage des Untersuchungsgebietes wird bestimmt durch den  $47^{\circ}21'40''$  N und den  $6^{\circ}22'$  E. Es ist auf der breiten Glattalsole zwischen Greifen- und Pfäffikersee gelegen und gehört somit dem alpennahen Teile des schweizerischen Mittellandes an. Der näheren Zugehörigkeit nach bildet es einen Bestandteil der grossen Industriegemeinde Uster und wird von der Glattalbahnlinie westlich tangiert und im Nordteil sogar durchschnitten. Altitude 450—458 m.

### 2. Morphologie, Geologie und Hydrographie

Orographisch repräsentiert der Algenstandort eine flache Bodendepression am unteren Ende des Niederterrassenschotterfeldes und flachen Aabachschwemmkegels von Uster. Zum Geländerahmen gehören ferner eine Anzahl drumlinartiger Erhebungen wie Haselrain, Tannberg und Bühl im E, Jungholz und Sandbühl im W. Den Untergrund bilden schwer durchlässige Glaziallehme, die meistenorts noch von einer Torfschicht geringerer Mächtigkeit überlagert werden.

Das Gesamtgebiet zerfällt in einen südlichen und einen nördlichen Abschnitt, für welche der Querriegel bei Bösch-Werrikon als Demarkationslinie dient. Zum Südabschnitt gehört das eigentliche Werrikerried, zum Nordabschnitt gehören die Sumpfwiesen



Gebietsübersicht u. Probenahmestellen

um die bewaldete niedere Anhöhe der Hirzern SE der SBB-Station von Nänikon. Der Südabschnitt wird durch eine aus der Richtung Brandschenke vorstossende Zunge der mineralischen Umgebung in zwei Lappen gespalten, von denen der eine mit dem Bahntrasse parallel läuft und das Hauptabzugsgewässer enthält, während der andere in ostnordöstlicher Richtung verläuft und in der Mitte leicht rinnig ausgetieft ist. Die Achsenlängen der beiden Hauptabschnitte betragen 600 bzw. 565 m.

Die hydrographischen Verhältnisse lassen sich wie folgt skizzieren. Das Werrikerried besitzt den Charakter einer typischen Quellflur. Am Rande der auskeilenden Schotterflächen finden ringsherum fortgesetzt Grundwasseraustritte statt. Das reichlich gelieferte Grundwasser wendet sich der Senke des Werrikerriedes zu, um von dort aus seinen Abzug in den Greifensee zu finden. Während früher die Austrittswässer von überall her in der Richtung des grössten Gefälles abflossen und ständige Inundationen verursachten, so hat man sie mit der Zeit in künstlichen Abzugsrinnen gesammelt. Die Hauptsammelader zieht auf der W-seite talabwärts. Ihren Ursprung hat sie am E-rande des Jungholzes; von hier aus erreicht sie in nordöstlicher Richtung das Werrikerried, nachdem sie unter der Ueberbrückung der Glattalbahnlinie hindurch gegangen ist. Von rechts her fliessen ihr zwei Seitengraben zu, die östlichere Teile des Glattenriedes entwässern und Austrittswasser aus der Gegend unterhalb des Weilers Gschwader herbeiführen. Von links her empfängt der Oberlauf nur ein unbedeutendes Grabenbächlein. Die Grabenbreite beträgt auf dieser ersten Wegstrecke durchwegs 2,2 m bei einer Sohllentiefe von durchschnittlich 40—50 cm und einer mittleren Wassertiefe von 10—20 cm. Gegenüber der Kreuzungsstelle von Bahn und Glattalstrasse tritt das Sammelgewässer in einen durch künstlichen Aushub entstandenen Weiher von etwa 175 m Länge und 20 m Breite ein. Seit das Wasserrecht von dem konzessionierten Betriebe („Säge“) aufgegeben und der Kolk nicht mehr unterhalten wird, macht die Verlandung durch Verschlammlung und Pflanzenbewuchs zusehends Fortschritte. Am Weiherende vor den Häusern bei Werrikon findet sich eine heute nicht mehr betätigte Schleuse, wo der Wasserschwall über die Wuhrwand in einen kleinen Kolk hinunterstürzt. An dieser Stelle mündet von rechts her der Nordgraben des Gebietes ein, der das Grundwasser aus dem Schotterfeld Winikon-Mühleholz herbeiträgt. Nach der Vereinigung mit einem Zuflussgraben von der S-Seite her umfliesst der Werrikerbach in einer westlich ausbiegenden Kurve, die flache Bodenerhebung von Werrikon um nach Passierung der Engstelle zwischen den Weilern Bösch und Werrikon in den Nordabschnitt des Gebietes überzutreten. Ca. 230 m unterhalb des Durchganges gabelt sich der Lauf. Die gerade Fortsetzung repräsentiert den ehemaligen Kanaltrakt, der heute eine tote Wasserader darstellt, während die einige Meter tiefer



auf der E-Seite hinunterführende und mit einer Gefällsstufe beginnende Rinne Wasser führt und als Wildbach bezeichnet wird. In der Gegend der „Schleife“ biegt der Lauf nach W ab, tastet dann dem erhöhten westlichen Rande der sumpfigen Aue entlang, um über die „Säge“ die „Beimühle“ zu erreichen. Als Mühlebach ziehen die Wasser zusammen mit denjenigen des Stogwiesenbaches in leicht SW-Richtung dem Greifensee entgegen.

Neben den fliessenden Gewässern spielen die stehenden des Gebietes eine höchst bescheidene Rolle. Sie beschränken sich in der Mehrzahl der Fälle auf Tümpelchen, die sporadisch vorkommen und auf eine grössere,  $\pm$  permanente Ueberstauungsfläche im Zentrum der östlichen Depression.

### 3. Das Klima.

Dasselbe unterscheidet sich kaum von demjenigen verwandter Mittellandorte. Die Jahresmenge des Niederschlags beträgt ca. 1150 mm, das Mittel der Temperatur  $8,4^{\circ}$  C. Von den Niederschlägen entfallen annähernd zwei Drittel auf das Sommerhalbjahr. Als besonders bezeichnend für das Gebiet führen wir die Häufigkeit der Nebelbildung an. In dieser Hinsicht wird die Lokalität kaum von einer zweiten mit ähnlicher allgemeiner Lage übertroffen. Eisbildung kommt so gut wie nicht vor. Das austretende Grundwasser ist selbst in den strengsten Wintermonaten derart hoch temperiert, dass es nicht zum Gefrieren kommt. Auch der gefallene Schnee kann sich an den vom Grundwasser benetzten Stellen in der Regel nicht halten (man vergleiche unsere Temperaturenmessungen!).

### 4. Gewässerkenzeichnung

Dem Kapitel über Hydrologie, Wasserphysik u. -chemie mögen folgende Angaben dienen. Die Zufuhr von Quellwasser aus den talaufwärts gelegenen Grundwasserträgern erleidet im Jahreszyklus keinen Unterbruch und variiert im Ertrage verhältnismässig wenig. Die abgegebenen Mengen erreichen auch ansehnliche Werte. Nach HUG (Lit. 2) sollen aus dem Schotterfeld Winikon-Mühleholz in den Wiesen bei Werrikon allein schon gegen 600 L/Min. abgestossen werden. Zu diesen Beträgen kommen dann noch die Sukkurse von der SW-Seite hinzu. Diese und weitere Voraussetzungen lassen es begreiflich erscheinen, dass die Bodendepression ober- und unterhalb Werrikon an permanenter Vernässung leidet und eigentlich überstaut sein müsste, wenn die verschiedenen Abzugsgräben nicht fortwährend oberflächliches Wasser sammeln und wegführen würden. Unterwassersetzungen ausgedehnter Geländepartien sind indes im unteren Gebietsabschnitt keine Seltenheit. Sie ereignen sich dann, wenn anlässlich längerer Regenperioden das ausgetretene Grundwasser um das oberflächlich sich ansammelnde

Hydrometeorwasser vermehrt wird. Wir können uns dabei auf Dutzende von eigenen Beobachtungen stützen, die wir im Laufe der letzten 20 Jahre gemacht haben. Die letzten Inundationsphänomene haben sich am 31. August und am 17. u. 18. September 1946 ereignet.

Quellwasser zeichnet sich neben einer gewissen Mengenkonzanz durch ausgeglichene Temperaturen aus, die in den Hauptabzugsgräben auf weite Strecken beibehalten werden und sich wenig weit vom Jahresmittel der Lufttemperatur der Gegend entfernen. Als Beweismittel fügen wir nachstehend die Ergebnisse einiger unserer Temperaturmessungen bei.

Datum	Lufttemp. ° C.	Wassertemp. ° C
2. Nov. 1943	14,0	11,5
17. Nov. 1943	5,0	9,5
8. Jan. 1944	-8,0	7,5
25. März 1944	4,0	8,0
10. April 1944	14,0	10,0
10. Juni 1945	18,0	12,0
25. Jan. 1947	-12,0	6,5

Nur in Extremfällen, d. h. zur Zeit der höchsten Sommer- und niedrigsten Wintertemperaturen verändert sich die Temperatur des abfließenden Austrittswassers mit der Entfernung vom Ursprungsort in nennenswerter Weise. Hierzu einige Belege:

1. Messung vom 25. August 1946 °C.  
 Lufttemperatur . . . . . 20,0  
 Wassertemperatur:  
 a) im Oberlauf bei der Probenahmestelle Nr. 1 . . 12,5  
 b) „ Unterlauf „ „ „ „ 30 . . 16,8
2. Messung vom 25. Januar 1947  
 Lufttemperatur . . . . . -12,0  
 Wassertemperatur:  
 a) im Oberlauf bei der Probenahmestelle Nr. 1 . . 6,5  
 a<sup>1</sup>) „ „ „ „ „ „ 4 . . 9,0  
 b) „ Unterlauf „ „ „ „ 30 . . 1,0

Die Probenahmestelle Nr. 1 liegt 450 m vom Quellort entfernt, Stelle Nr. 4 (Seitengraben) dagegen hart an der Aufstosstelle des Grundwassers. Aus den Messungsergebnissen folgert, dass auf der 1320 m langen Fliesstrecke von Probenahmest. Nr. 1 bis zu derjenigen von Nr. 30 und bei einem Gesamtgefälle von 5 m das Quellwasser an einem warmen Sommertag zufolge des Kontaktes mit der wärmeren Luft eine Temperaturzunahme um 4,3°

C erfährt, während es sich an einem sehr kalten Wintertag bei gleicher Distanz um  $5,5^{\circ}\text{C}$  und von der Grundwasseraufstossstelle an sogar um  $8^{\circ}\text{C}$  abkühlt.

Die täglichen und jahreszeitlichen Temperaturamplituden erreichen in den Quellgräben ein viel kleineres Ausmass als dies z.B. in Sümpfen mit stagnierendem Wasser und stärker moorigen Böden der Fall ist. In welchem Betrage etwa die Temperatur eines Tümpelgewässers sich über diejenige eines Bachgrabens zu erheben vermag, sei durch folgendes Beispiel aus dem Gebiete aufgezeigt:

Datum: 10. Juni 1945, Messtelle: Schoenetum-Tümpelchen, Lufttemp.:  $22,5^{\circ}\text{C}$ , Wassertemp.:  $27^{\circ}\text{C}$ .

Die austretenden Grundwässer sind harte Wässer. Im Laufe unserer Untersuchungen liessen sich diesbezüglich folgende Feststellungen machen:

Karbonathärte in franz. Härtegraden a) im Hauptgraben 28,0; b) in einem Seitengraben 30,5; in einem Tümpelchen 31,5.

Ausserdem ist das fortrinnende, ursprünglich sauerstoffarme Sickerwasser bald mit gelösten Sauerstoff annähernd gesättigt. Und dieser Sauerstoff ist der grosse Reinigungsfaktor des Wassers. Beim Durchfliessen des Riedes ist der Sauerstoffverlust verhältnismässig gering, weil die dem Mineraboden aufruhende torfige Decke wenig mächtig ist und auch sonstige organische Zersetzungsprodukte als Sauerstoffverbraucher wenig in Betracht fallen. Unter den herrschenden Bedingungen muss dem Wasser ein geringer Eisengehalt eigen sein, und in der Tat begegnet man in den Gräben keinen oder nur geringfügigen Ockerbildungen.

## 5. Höhere Vegetation.

Die makroskopische Komponente der Vegetation setzt sich aus einer charakteristischen Kombination bestimmter Blütenpflanzen und einer kleineren Zahl ansehnlicher Kryptogamen zusammen. Ueberall, wo Grundwasser zutage tritt und sich über grössere Flächen ergiesst, entstehen die bekannten Sumpflandschaften, die ein eigenes Pflanzenleben hegen. Vegetationen von Schilf, Sauergräsern, Schachtelhalmen, Laichkräutern, Wasserkressen, Wasserrinden, Moosen usw. bilden einen schroffen Gegensatz zu den Wiesen und Aeckern der kiesigsandigen Umgebung. Im Zentrum des Riedsumpfes hat sich im Laufe der Zeit ein wenig mächtiger Torfkörper gebildet, der in früheren Jahren wirtschaftlich ausgenutzt worden ist. In der Hauptausdehnung wird der Riedboden von Pflanzenbeständen bestockt, die soziologisch als *Schoenetum*, *Juncetum* (*Juncetum subnodulosi*) und modifizierte *Molinietum* angesprochen werden müssen. An einer engumrissenen Stelle hat bis in die jüngste Zeit hinein ein Moorwäldchen existiert, das dann im Sommer 1946 grösstenteils entfernt worden ist. In den Abzugsgräben findet eine den speziellen Verhältnissen



angepasste Vegetation bestes Gedeihen. Die Ueppigkeit derselben erreicht einen solchen Grad, dass der Hauptgraben mindestens einmal pro Jahr ausgemäht und gesäubert werden muss, wenn es nicht zu nachteiligen Verstopfungen und Stauungen des Wassers kommen soll. Die die Gräben besiedelnde höhere Vegetation setzt sich nach unserer Feststellung aus folgenden Arten zusammen: *Equisetum limosum*, *Potamogeton coloratus*, *crispus*, *densus* u. *pusillus*, *Sparganium ramosum* (*neglectum*), *Alisma* *Plantago* *aquatica*, *Phragmites communis*, *Glyceria fluitans*, *Carex acutiformis*, *Schoenoplectus lacustris*, *Juncus lamprocarpus*, *obtusiflorus*, *Caltha palustris*, *Nasturtium officinale*, *Sium erectum*, *Myriophyllum verticillatum*, *Callitriche palustris* ssp. *verna*, *Myosotis palustris*, *Mentha aquatica*, *Veronica Anagallis aquatica*.

Die Moose treten im Hauptabzugsgewässer als Besiedelungselement stärker zurück. Den Hauptgrund hierfür erblicken wir im mangelhaften Vorhandensein von Bachbettsteinen. An der Sturzstelle zwischen Werrikon-Bösch und der Schleife überspringt das Wasser Rasen von *Brachythecium rivulare*. Im Gewässerabschnitt zwischen Bahntrasse und „Säge“, wo das Bachbett steiniger ist und die Fliessgeschwindigkeit des Wassers gesteigert, siedeln *Fontinalis antipyretica* u. *Cratoneuron commutatum* var. *irrigatum* f. *pachyneura*.

In den Abzugsgräben begegnet man das ganze Jahr grösseren Massen von makroskopischen Algen. In der Regel handelt es sich um Strähnen von Fadenalgen, die ihren Fixationspunkt an den submersen Stengelteilen von phanerogamischen Sumpf- und Wasserpflanzen haben oder schliesslich rasenartig den Bachgrund überziehen. Den üppigsten Ansammlungen begegnet man im Frühjahr. Das Aussehen dieser Algenmassen variiert in der Farbe je nach Alter und Erhaltungszustand vom lebhaften Grün über Braun bis zum Grau. Die ständig umflossenen und nach der Fliessrichtung ausgerichteten Algenbündel filtrieren das Wasser in Bezug auf mitgeführte Suspensionen minerogener und biogener Natur. Aeltere Stadien sind daher ganz mit anhaftenden Schmutzteilen beladen und durchsetzt und grau getönt. Ein Teil der mineralische Beimengung muss wohl auch der biogenen Entkalkung zugeschrieben werden. In den flutenden Filtern kommt es fortgesetzt zu kleineren Zersetzungsprozessen; doch werden die Restprodukte und Abfälle stets rasch fortgespült. Im Schutze der grösseren Algenaggregate halten sich mancherlei kleine und kleinste pflanzliche und tierische Lebewesen auf, die auf diese Weise Sicherheit vor dem Weggeschwemmtwerden geniessen. Diese von blossem Auge sichtbaren Algenansammlungen im Gebiete werden gebildet von *Zygnemen*, *Spirogyren*, *Microspora*-Arten, *Vaucherien*, *Chaetophora elegans*, *Chlorosaccus ulvaceus* und *Batrachospermum*. *Vaucheria clavata* bildet unterhalb der „Schleife“ zur Frühjahrszeit ausgedehnte Vliese am Bachgrunde; *Chlorosaccus* sitzt und flutet an Stengeln von Phanerogamen;

*Batrachospermum moniliforme* produziert da und dort am Bachgrunde und namentlich an dem Wuhr unterhalb des Weiher's pinselartige Kolonien; *Chaetophora elegans* entwickelt im Frühling an Stengeln und Blättern untergetauchter Pflanzenteile ihre üppigen Kolonien.

## II. DIE ALGENFLORA

### 1. Die Algenproben

- Nr. 1: Ausquetschmaterial aus Fadenalgenwatten und Aufwuchsmaterial ab Phanerogamen aus dem Hauptquellgraben an der SW-Ecke, nahe der Bahntrasse. Wasser mässig bewegt, ca. 30 cm tief, mit einer Temp. von 12,8° C. 31. Juli 1936.
- Nr. 2: Schwimmwatten von Fadenalgen und Ausquetschmaterial daraus. Probe aus dem ersten rechtsseitigen hakenförmig gekrümmten Seitengraben in etwa 5 m Entfernung von Fassungsstelle Nr. 1. Wassertiefe 40—120 cm, Wassertemp. 12,9° C, Wasser wenig bewegt. 31. Juli 1936.
- Nr. 3: Schwimmwatten von Fadenalgen und Ausquetschmaterial daraus, sowie Epiphytenmaterial ab *Ranunculus flaccidus*-Sprossen. Von ebenderselben Stelle. Wassertemp. 4,5° C. 22. Febr. 1939.
- Nr. 4: Ausquetschmaterial aus Schwimmwatten abgestorbener Fadenalgen und Aufwuchsmaterial ab *Ranunculus flaccidus*-Trieben. Material vom gleichen Standort. Wassertemp. 9 C. 17. Nov. 1943.
- Nr. 5: Schwimmdeckenmaterial von Fadenalgen und submers flutende Algensträhnen, sowie Ausquetschmaterial daraus. Hauptgraben, einige Dutzend Meter unterhalb von Fassungsstelle Nr. 1. Wassertemp. 11,5° C. 2. Nov. 1943.
- Nr. 6: Grundschlammalgen vom gleichen Ort. Wassertemp. 10,0° C. 17. Nov. 1943.
- Nr. 7: Ditto, unweit vom vorigen Ort. Wassertemp. 10,0° C. 10. Apr. 1944.
- Nr. 8: Flottierende Fadenalgen und Ausquetschmaterial daraus, vom gleichen Ort. Wassertemp. 10,0° C. 10. Apr. 1944.
- Nr. 9: Grundalgen vom gleichen Ort. Wassertemp. 12,0° C. 20. Mai 1945.
- Nr. 10: Epilithisches Material vom Gewässergrund des Hauptgrabens unweit der bereits genannten Fassungsstellen. Wassertemp. 12,0° C. 20. Mai 1945.
- Nr. 11: Aufwuchs- und Zwischenmaterial aus Rasen von *Scorpidium scorpioides* u. *Chara fragilis* aus dem kleinen linksseitigen Zuflussgraben gegenüber der Bahn-Strassenkreuzung. Wassertiefe 2—3 cm.

- Wassertemp. 9,0° C. 17. Nov. 1943.
- Nr. 12: Ausquetschmaterial von derselben Moosart aus einem mit Quellwasser gespiesenen Tümpelchen bei den Weidebüschen N genannten Seitengrabens. Wassertiefe wenige cm.  
Wassertemp. 8,0° C. 2. Nov. 1943.
- Nr. 13: Ditto plus zarte flottierende Flöckchen einer Fadenalge. Ort derselbe. Wassertemp. 10,0° C. 10. Apr. 1944.
- Nr. 14: Ditto plus Ausquetschmaterial aus *Aneura pinguis* var. *angustior*-Vegetation. Ort derselbe.  
Wassertemp. 14,0° C. 20. Mai 1945.
- Nr. 15: Grundalgen vom S-Ende des Weiher. Wassertiefe 8 cm. Wassertemp. 20,0° C. 31. Juli 1945.
- Nr. 16: Ausquetsch- und Abstreifmaterial von submersen Pflanzenteilen derselben Lokalität.  
Wassertemp. 14,0° C. 18. Juli 1945.
- Nr. 17: Fadenalgenwatten und Ausquetschmaterial daraus. Entnahmeort wie bei Nr. 11. Wassertiefe 30 cm.  
Wassertemp. 17,5° C. 31. Juli 1945.
- Nr. 18: Ausquetschmaterial aus Rasenstücken von *Scorpidium scorpioides* u. wenig *Chara fragilis* aus dem Seichtwasser eines Torfstichtümpels E des Wäldchens neben dem südlichen Weiherende. Wassertiefe 1—2 cm. Wassertemp. 26,0° C. Karbonathärte 26 (° fr.) pH 7,5.  
10. Juni 1945.
- Nr. 19: Material als Ausquetsch und Abschöpf aus dem Wasser eines Schönetum-Tümpelchens im E Riedteil mit *Utricularia minor*, *Scorpidium scorpioides* u. diversen Fadenalgen als sichtbare Vegetationskomponenten. Wassertiefe 2—3 cm. Wassertemp. 27,0° C. Karbonathärte 31,5 (° fr.)  
10. Juni 1945.
- Nr. 20: Grundalgen aus dem Seichtwasser eines Schönetum-Tümpelchens im gleichen Riedabschnitt. Wassertemp. 24,0° C. 20. Mai 1945.
- Nr. 21: Moosrasenausquetsch von einem Quellgraben gegen das östliche Riedende. Wasser rasch bewegt. Wassertiefe 4—7 cm. Wassertemp. 11,0° C. 1. Apr. 1945.
- Nr. 22: Ausquetschmaterial aus Rasen von *Scorpidium scorpioides* aus einem Kopfbinsenbestand desselben Riedabschnittes. Wassertemp. 9,0° C. 18. März 1945.
- Nr. 23: Fadenalgensträhnen und Ausquetschmaterial daraus aus einem Quellgraben nahe dem E Riedende. Wasser rasch fließend. Wassertiefe 7—8 cm. Wassertemp. 8,0° C. Karbonathärte 30,5 (° fr.) pH 7,5.  
10. Juni 1945.
- Nr. 24: Aufsammlung von *Chaetophora elegans*- u. *Batrachospermum moniliforme*-Lagern von der Wuhrstelle bei der Grabenvereinigung unweit des unteren Weihe-



- rendes. 18. Mai 1944.
- Nr. 25: *Characeen*material u. Begleitflora von Grunde des Bachkolkes an der NW-Ecke des Werrikerriedes. Wasser rasch bewegt. Wassertiefe 20—40 cm. 18. Mai 1944.
- Nr. 26: Fadenalgensträhnen und Ausquetschmaterial daraus von einem in der Nähe der Bachüberbrückung S von Werrikon einmündenden linksseitigen Grabenzuge mit schwärzlich getöntem Schlammgrunde. Wasser langsam fliessend. 7. Apr. 1946.
- Nr. 27: Flutende Algensträhnen und Ausquetschmaterial daraus vom N-Graben nahe der Vereinigungsstelle mit dem Hauptgewässer. Wasser in mässiger Bewegung. Wassertiefe 20 cm. 31. März 1946.
- Nr. 28: Ausquetschmaterial aus dem Pflanzengewirr eines *Myriophyllum verticillatum*-Bestandes vom S-Rand des Werrikerbaches unmittelbar oberhalb der Glattalbahnüberführung S der SBB-Station Nänikon. Wassertiefe 50 cm. Wasser in mässiger Bewegung. Wassertemp. 16,5° C. 25. Aug. 1946.
- Nr. 29: Ausquetschmaterial aus Rasenstücken gebildet von *Fontinalis antipyretica* am Grunde des Mühlebaches oberhalb der „Säge“. Wasser rasch bewegt. 7. Apr. 1946.
- Nr. 30: Auspressmaterial aus *Cratoneuron commutatum* var. *irrigatum* f. *pachyneura*-Rasen aus dem Mühlebach oberhalb der „Säge“. Standortsfaktoren dieselben. 7. Apr. 1946.
- Nr. 31: Inkrustationsmaterial ab Bachbettsteinen des Mühlebaches vom gleichen Ort. 7. Apr. 1946.
- Nr. 32: Bachalgen von der Gewässerstelle unterhalb der „Schleife“. 31. März 1946.

## RESUMÉ:

- a) Proben von Standorten mit stagnierendem Wasser: 12, 13, 14, 15, 16, 18, 19, 20, 22.
- b) Proben von Sandorten mit bewegtem Wasser: 1, 5, 6, 7, 8, 9, 10, 21, 23, 24, 25, 27, 29, 30, 31, 32.
- c) Proben von Standorten mit reichlicher Moosvegetation: 11, 12, 13, 14, 18, 19, 21, 22, 29, 30.
- d) Grundschlammproben: 6, 7, 9, 15, 20.
- e) Proben mit epilithischem Material: 10, 31.

## 2. Liste der ermittelten Algen

Es bedeuten: 1, 2, 3 usw. die Nummern der Proben, die Buchstaben geben Auskunft über die Abundanzverhältnisse der Arten, nämlich: rrr = vereinzelt, rr = spärlich, r = ziemlich spärlich, c = häufiger, cc = häufig, ccc = in grossen Mengen.

## CYANOPHYCEAE

- Microcystis flos aquae* (Wittr.) Kirchn. — 19rr.  
 — *pulverea* (Wood) Mig. — 15rr, 20rrr.  
*Aphanocapsa Elachista* W. u. G. S. West var. *conferta* W. u. G. S. West — 14rrr.  
*Aphanothece Castagnei* (Bréb.) Rabenh. — 13rr, 18r.  
 — *prasina* (Spreng.) A. Br. — 18r.  
 — *stagnina* (Spreng.) A. Br. — 13rrr.  
*Chroococcus giganteus* W. West — 11rrr, 12r, 13 rr, 14rr, 15rr, 16rr, 18c, 19r, 20rr.  
 — *minutus* (Kütz.) Näg. — 2rr, 3rrr, 4rrr, 6rrr, 8rr, 12r, 16r, 18r, 19c, 20c.  
 — *spec.* — 30rr.  
 — *turgidus* (Kütz.) Näg. — 2rrr, 4rr, 6rr, 11r, 12rr, 13r, 14r, 15rr, 16r, 18r, 19c—cc, 20c—cc, 22rrr, 25rrr, 27rrr, 28rrr.  
*Gloeocapsa quaternata* (Bréb.) Kütz. — 18r.  
*Gloeotheca confluens* Näg. — 22rrr.  
*Gomphosphaeria aponina* Kütz. — 3rrr, 4rrr, 6rrr, 7rrr, 11r, 12r—c, 13rr, 14rr, 15rr, 16r, 18r—c, 19c—cc, 20c, 21rrr, 22rrr.  
*Woronichinia Naegelianae* (Ung.) Elenk. — 15rr, 16rrr, 18r—c, 25rrr.  
*Coelosphaerium Kuetszingianum* Näg. — 2rr, 4rr, 11rr, 19rr, 20rr.  
*Merismopedia aeruginea* Bréb. — 24rr, 25rrr.  
 — *elegans* A. Br. — 19rrr.  
 — *glauca* (Ehrenb.) Näg. — 1r, 6rr, 7rrr, 10rrr, 11rr, 12rrr, 13rrr, 14rrr, 15rr, 16rr, 17rrr, 18c, 19c—cc, 20rrr, 22rrr, 28rrr.  
 — *punctata* Meyen — 16rrr, 18c.  
*Synechococcus aeruginosus* Näg. — 11rrr, 12rrr, 13rrr, 14rrr, 15rr, 16rrr, 18r, 19rrr, 20rrr, 22rrr.  
*Chlorogloea microcystoides* Geitler — 13rrr.  
*Stigonema informe* Kütz. — 18rrr.  
 — *turfaceum* Cooke — 22rr.  
*Tolypothrix penicillata* Thur. — 27rrr.  
*Scytonema mirabile* (Dillw.) Born. — 22rr.  
 — *ocellatum* Lyngb. — 18rrr.  
*Nostoc minutum* Desmaz. — 18rr.  
 — *sphaericum* Vauch. — 14rrr, 18rrr, 19rrr, 22rrr.  
*Anabaena spec. steril.* — 11rrr, 18r—c, 19rrr.  
*Spirulina tenuissima* Kütz. — 18r.  
*Pseudanabaena catenata* Lauterb. — 4rrr, 14rr, 15rr, 16r, 18rrr, 29c—cc, 20c—cc.  
*Oscillatoria amphibia* Ag. — 5r, 6r—c, 7r—c, 11c, 13r, 19c—cc.  
 — *Borneti* Zukal — 3rrr, 4r, 5rrr, 6rrr, 7rrr, 8r, 11r, 12cc, 13r, 14c, 25rrr.  
 — *curviceps* Ag. — 15rrr.  
 — *formosa* Bory — 19rr.  
 — *geminata* Menegh. — 29rr, 30rr.  
 — *ornata* Kütz. — 8r, 13r, 14rrr, 18rr.  
 — *princeps* Vauch. — 18rrr, 20rrr.  
 — *sancta* Kütz. — 4r—c, 7rrr, 12rr, 14rrr, 16rr, 18r.  
 — *splendida* Grev. — 5rr, 11c.  
 — *tenuis* Ag. — 4r, 6rrr, 7rr, 8r, 11r, 13rrr, 14rrr, 15r, 16r, 17rrr, 18r, 19r, 20r, 25rrr, 28rrr, 32rrr.  
 — var. *nigra* Schkorb. — 27rr.  
*Lyngbya aestuarii* (Mert.) Liebmann — 26r.  
 — *Digueti* Gom. — 19rr.  
 — *Lagerheimii* (Möb.) Gom. — 24rr.

## CHRYSOPHYCEAE

- Chrysococcus rufescens* Klebs — 22r—c.  
*Dinobryon divergens* Imh. — 17rrr.

- sertularia Ehrenb. — 4rrr, 12r—c, 13rr, 14rrr, 16rr, 19r, 20r, 21rrr, 25rrr.
- utriculus Stein — 22r.

#### FLAGELLOPHYCEAE

- Euglena deses Ehrenb. — 26rrr.
- intermedia (Klebs) Schmitz — 20rrr, 24rrr.
- mutabilis Schmitz — 15rrr, 16rrr, 18rrr.
- spec. — 11rrr.
- spirogyra Ehrb. — 18rrr, 26rr.
- viridis Ehrb. — 13rrr, 26rr.
- Lepocinclis fusiformis (Carter) Lemm. — 12rrr.
- Phacus acuminata Stokes — 18rrr.
- caudata Hübn. — 25rrr, 26rrr.
- curvicauda Swir. — 26rrr.
- Trachelmonas abrupta (Swir.) em. Defl. var. arcuata (Playf.) Defl. — 18rr.
- abr. var. minor Defl. — 26rrr.
- hispida (Perty) Stein em. Defl. — 18r, 19rrr, 26rrr.
- intermedia Dang. — 11rrr, 19rrr, 25rrr.
- volvocina Ehrenb. — 18rr, 26rrr.
- Peranema trichophorum (Ehrenb.) Stein — 15rr, 16rr.
- Petalomonas Steinii Klebs — 7rr.
- Anisonema acinus Duj. — 6rrr, 9rrr.
- Entosiphon sulcatum (Duj.) Stein — 19rrr.
- Dinema griseolum Perty — 15rrr.

#### DINOPHYCEAE

- Hemidinium nasutum Stein — 4ccc.
- Gymnodinium palustre Schilling — 16rr.
- Glenodinium uliginosum Schilling — 27rrr.
- Peridinium cinctum (Müll.) Ehrb. — 20rr.
- inconspicuum Lemm. — 18rr, 19rr.
- spec. — 18r.
- umbonatum Stein var. inaequale Lemm. — 12rrr, 15rr, 16rr, 19rr, 20c.

#### XANTHOPHYCEAE

- Chlorosaccus ulvaceus Messik. et Vischer — 32r—c.
- Ophiocytium cochleare A. Br. — 3rrr, 4rrr, 11rrr.
- Tribonema affine G. S. West — 7 r—c.
- viride Pasch. — 26rrr.

#### BACILLARIOPHYCEAE

- Melosira ambigua (Grun.) O. Müll. — 5rrr.
- arenaria Moore — 1rrr, 2rr, 4rrr, 5rrr, 6rrr, 7rrr, 8rrr, 9rrr, 10rrr, 24rrr, 27rr, 28rrr, 29rrr, 30r, 32rrr.
- varians Ag. — 1rr, 2rrr, 3c, 4rrr, 5r, 7rrr, 8rrr, 9r—c, 10r—c, 25rrr, 27r—c, 29rrr, 30rrr, 32rrr.
- Cyclotella comta (Ehrenb.) Kütz. — 2rrr, 3r—c, 4rr, 7r, 13r—c, 14r, 15rr, 16rr, 21rrr, 24rr, 25r.
- lusus ovalis A. Mayer — 25r.
- Kuetzingiana Thwait. — 1rrr, 2c, 3ccc, 4c—cc, 5r, 6c—cc, 7r, 8r, 9c, 10cc, 12c—cc, 13rr, 14c, 15r—c, 16r—c, 17rrr, 20rr, 24r—c, 28c, 27rr, 28ccc, 29rrr, 13rr, 14c, 15r—c, 16r—c, 17rrr, 20rrr, 20rr, 24r—c, 25c, 27rr, 28ccc, 29rrr, 30r., 32rr.
- var. planetophora Fricke — 14r.
- Meneghiniana Kütz. — 1rrr, 3rrr, 4rrr, 5rrr, 7rrr, 16rr, 21rr, 30rrr.



- operculata (Ag.) Kütz. — 1c, 2cc, 4r, 5r, 7c, 9r, 10rrr, 11rrr, 15rrr, 21c, 24rr, 25rr.
- Tabellaria fenestrata (Lyngb.) Kütz. — 3rrr, 15rrr, 24r, 25r, 27r, 32rrr.
- flocculosa (Roth) Kütz. — 1rrr, 2rr, 3rr, 15rrr, 16rrr, 18rrr, 24rrr, 25rrr, 30rrr, 32rr.
- Diatoma elongatum Ag. — 24rrr, 25rrr.
- — var. tenue (Ag.) Kütz. — 1rrr, 3rr, 9rr, 10rr, 24rrr.
- hiemale (Lyngb.) Heib. var. mesodon (Ehrenb.) Grun. — 2rr, 3c, 4r, 5rrr, 6rrr, 7rr, 8rrr, 9rrr, 12rrr, 24rrr, 25rrr.
- vulgare Bory var. capitatum Grun. — 2rrr.
- — var. ovale (Fricke) Hust. — 8rrr.
- Meridion circulare Ag. — 1r—c, 2r—c, 3r—c, 4r, 5r, 6r, 7r, 8c, 9r—c, 10r—c, 11rr, 14rrr, 15r, 16r, 21r, 24r, 25r, 26r, 27r—c, 28rrr, 29rrr, 30rr, 31rrr, 32r.
- Opephora Martyi Hérib. — 15rrr, 25rrr.
- Fragilaria capucina Desmaz. — 1c, 2r—c, 3c, 4r, 5r—c, 6c—cc, 7rr, 8r, 9cc, 13rr, 23c, 25r, 26r—c, 27r—c, 28c, 32rrr.
- bicapitata A. Mayer — 9rrr.
- brevistriata Grun. — 15rr, 24r, 30rr.
- construens (Ehrenb.) Grun. — 2rr, 7r—c, 24r, 30r.
- — var. binodis (Ehrenb.) Grun. — 1rr, 2rr, 3rr, 6r, 7c—cc, 9rrr, 10r, 11rrr, 24r—c, 25c.
- — var. venter (Ehrenb.) Grun. — 1r, 2r—c, 3r—c, 4r, 6c, 7c, 9cc, 10r—c, 16rr, 24c, 25r—c, 30r—c.
- crotonensis Kitton — 24rrr, 28rr.
- leptostauron (Ehrenb.) Hust. — 1rr, 2rrr, 3rrr, 4rr, 5r, 6rr, 7rr, 8rrr, 9rr, 16rrr, 24c, 25rr, 30rr.
- — var. dubia Grun. — 5c, 7cc, 9rrr, 15rr, 16rrr, 24c—cc, 25r—c, 30rr.
- pinnata Ehrenb. — 1r—c, 2c, 3c, 4r, 5r—c, 6ccc, 7ccc, 8r, 9ccc, 10c—cc, 11rrr, 12r, 13rrr, 14rr, 15r—c, 24c—cc, 25cc, 27rr, 30r—c, 32rr.
- — var. lancettula (Schumann) Hust. — 4r—c, 7r—c, 9cc, 24cc, 25c, 30r.
- Synedra acus Kütz. — 3c, 5rrr, 14rr, 16rr, 17rr, 19rr.
- — var. radians (Kütz.) Hust. — 1r, 2r, 4c—cc, 5rr, 6cc, 7r, 8r, 9rrr, 10rrr, 11rr, 12r, 13rr, 14rrr, 15r, 19rr, 20r, 21r, 22rr, 24r—c, 25r, 26c, 27r.
- amphicephala Kütz. — 1ccc, 2cc, 3r—c, 4cc, 5r—c, 6cc, 7cc, 8c, 9ccc, 10ccc, 12rrr, 13rr, 14rr, 15r, 19rrr, 24c—cc, 25r, 27cc.
- — var. austriaca Grun. — 5r—c, 7cc, 8c—cc, 27c.
- capitata Ehrenb. — 1rrr, 2rr, 3r—c, 4r—c, 5rrr, 6r, 7rr, 12rrr, 13r, 15rr, 16rrr, 24rr, 25rr.
- minuscula Grun. — 1rr, 5r, 7cc, 21rr, 23r—c, 24rr, 27c.
- parasitica (W. Sm.) Hust. — 4rrr, 5rrr, 7rrr, 15rrr, 24r, 25rr.
- puellaris Messik. — 5rr, 30rr.
- rumpens Kütz. — 1c, 2c—cc, 3ccc, 4cc, 5r—c, 6cc, 7c, 8c, 9cc, 10c—cc, 13r, 15rr, 21r, 23r, 24c, 25r, 27r—c, 28r—c, 30rrr, 32rr.
- ulna (Nitzsch) Ehrenb. — 1cc, 2r—c, 3c, 4r—c, 5cc, 6r, 7r—c, 8ccc, 9r, 10c—cc, 12r, 13rr, 14rr, 15r—c, 16r, 17rr, 20rrr, 21c, 22rrr, 23ccc, 24r—c, 25r, 26r, 27rr, 28r—c, 29rrr, 30r, 31rrr, 32r.
- — var. aequalis (Kütz.) Hust. — 1rr, 3r—c.
- — var. biceps (Kütz.) v. Schönfeldt — 5r, 6r, 7rr, 9rrr, 11rr, 12r, 13rrr, 15r, 16rr, 17rrr, 20rrr, 24rr, 25r, 27rr, 28r—c, 30r, 32rrr.
- — va. danica (Kütz.) Grun. — 3rrr, 4rr, 5rrr, 7r, 10rr, 16r.
- Eunotia arcus Ehrenb. — 1r, 2r, 3rr, 4r, 5rr, 6r, 7rr, 8rrr, 9r, 10rr, 11rrr, 12c—cc, 13r, 14c, 15r, 16r, 17rrr, 18rr, 19r—c, 20r—c, 21r, 22cc, 24r, 25r, 26rrr, 27rr, 28r—c, 29rrr, 30rrr, 32rrr.
- flexuosa Kütz. — 15rrr.
- formica Ehrenb. — 25rrr.

- *gracilis* (Ehrenb.) Rabenh. — 18rrr, 24rrr.
- *lunaris* (Ehrenb.) Grun. — 1rrr, 2rr, 3rrr, 4rr, 5rr, 6rrr, 7rrr, 8rr, 10rrr, 11rrr, 13rrr, 14rrr, 16rr, 17rrr, 21r, 22rrr, 23r, 24rr, 25rrr, 27rrr, 30rrr.
- — *var. capitata* Grun. — 4rrr, 16rrr.
- — *var. subarcuata* (Näg.) Grun. — 2rrr, 27rrr.
- *parallela* Ehrenb. — 16rrr.
- *pectinalis* (Kütz.) Rabenh. *var. minor* (Kütz.) Rabenh. — 2rr, 4rrr, 30rr.
- *praerupta* Ehrenb. *var. muscicola* Peters. — 4rrr.
- *tenella* (Grun.) Hust. — 4rrr, 30rrr.
- Cocconeis pediculus* Ehrenb. — 1cc, 6rr, 7rr, 8rr, 24rrr, 29r—c, 30c, 32rrr.
- *placentula* Ehrenb. — 1r, 2cc, 3r, 4cc, 5r—c, 7rr, 13rr, 15rr, 17rrr, 18rrr, 24rrr.
- — *var. euglypta* (Ehrenb.) Cleve — 1c, 2cc, 4cc, 5r—c, 6r—c, 7r, 8r, 9r, 10r, 12rrr, 13rr, 14rrr, 15r, 16r, 19rrr, 21rr, 24r—c, 25rr, 27ccc, 28r—c, 29ccc, 30rr, 31rrr, 32rr.
- — *var. klinoraphis* Geitler — 30rrr.
- — *var. lineata* (Ehrenb.) Cleve — 1rr, 2c—cc, 3r, 4r, 5r, 10r, 1rr, 24r—c.
- *thumensis* A. Mayer — 7rrr, 25rrr.
- Achnanthes Clevei* Grun. — 3rrr, 5rr, 6rrr, 7rrr, 30rrr.
- *conspicua* A. Mayer — 3rrr, 4rrr, 5rrr, 6r, 7rrr, 9rrr, 10rrr, 24rr, 25rrr, 30rrr.
- *exigua* Grun. — 24rr, 30rr.
- — *var. heterovalvata* Krasske — 30rr.
- *exilis* Kütz. — 3rrr, 4rr, 6rr, 7rr, 8rrr, 10rrr, 22rrr, 24rrr.
- *flexella* (Kütz.) Brun — 1rr, 2rr, 3rr, 4r, 6r, 7r—c, 8r, 9rrr, 10rrr, 11rrr, 12r, 13r—c, 14r, 15r, 16r, 18r, 19r—c, 20c—cc, 21r—c, 22r, 23rrr, 24r—c, 25r, 27r—c, 30rrr, 32rrr.
- — *var. alpestris* Brun — 12rr, 18r, 19rrr.
- *lanceolata* Bréb. — 1rrr, 2rr, 4rr, 5rr, 24r, 30r, 32rrr.
- — *var. rostrata* Hust. — 5rr, 7rrr, 10rrr, 25rrr, 27rrr, 30rr.
- *lapponica* Hust. — 5rrr, 7rrr, 11rrr, 12rr, 14rrr, 15r, 18rr, 21r, 22rrr, 24rr, 25rr, 27rr, 31rrr.
- *linearis* W. Smith — 2rrr, 3r, 4rrr, 5r, 7rrr, 11rrr, 12r, 13r, 14r, 15rrr, 21rrr, 24rr, 30rrr.
- *microcephala* Kütz. — 2rr, 3r—c, 7rr, 14rr, 15rr, 18rr, 22rr, 24c, 25rrr.
- *minutissima* Kütz. — 1r—c, 2cc, 3ccc, 4cc, 5rr, 6c, 8c, 9rrr, 10cc, 13cc, 14r—c, 19r, 23rr, 24c, 25cc, 26cc, 27c, 28cc, 29rrr, 30cc, 31rr.
- — *var. cryptocephala* Grun. — 1ccc, 2ccc, 3ccc, 4cc, 5r, 6cc, 7cc, 8cc, 9r, 10ccc, 11r, 12c, 13ccc, 14r—c, 15c, 16ccc, 18cc, 19r, 20r, 21ccc, 22ccc, 23r, 24c, 25cc, 26cc, 27cc, 28ccc, 29rrr, 30cc, 31rr, 32rr.
- *subexigua* Hust. — 18rrr.
- Rhoicosphenia curvata* (Kütz.) Grun. — 1rrr, 2rr, 4rrr.
- Mastogloia Smithii* Thwait. *var. lacustris* Grun. — 11rrr, 12rrr, 13rr, 15rr, 16rr, 18rrr, 19rr, 21rrr, 22rrr.
- Amphipleura pellucida* Kütz. — 1rr, 2rrr, 3rrr, 4r—c, 5r, 6r, 7r, 8r, 9rrr, 10r, 14rrr, 15rrr, 23c—cc, 24rrr, 25rrr, 27r—c, 30rrr.
- Frustulia vulgaris* Thwait. — 5rrr, 7rrr, 23rrr, 24rrr, 27rrr, 30rr.
- Gyrosigma attenuatum* (Kütz.) Rabenh. — 3rrr, 5rrr, 9rrr, 10rrr, 15rrr, 17rrr, 21rrr, 24rr, 25rr, 26rrr, 27rr, 28rrr, 30r, 32rrr.
- Caloneis alpestris* (Grun.) Cleve — 2rrr, 3rrr, 4rr, 5rrr, 6r, 7rrr, 8rrr, 9rrr, 11rr, 12r, 13rrr, 14rrr, 15rr, 16r, 18rr, 19rr, 20rr, 21rr, 22rr, 23rrr, 24rrr, 30rrr, 32rrr.
- *bacillum* (Grun.) Mereschk. — 2rrr, 4rrr, 30rrr.
- *latiuscula* (Kütz.) Cleve — 5rrr, 11rr, 12rrr, 13rr, 14rrr, 15rrr, 16rrr, 20rrr, 24rr, 25r, 30rrr.
- *obtusa* (W. Sm.) Cleve — 13rrr, 15rr, 16rr, 20rrr.

- silicula (Ehrenb.) Cleve — 3rrr, 4rrr, 5rrr, 6rr, 7rrr, 9rrr, 11r, 12rrr, 15rrr, 16rrr, 18r, 24rrr, 25rrr, 26rrr, 27rrr, 30rr.
- — var. truncatula Grun. — 3rrr, 5rrr, 10rrr, 11rr, 15rrr, 24rrr, 26rrr, 30rrr, 32rrr.
- Neidium affine (Ehrenb.) Cleve — 6rrr, 31rrr.
- — var. amphirhynchus (Ehrenb.) Cleve — 26rrr, 29rrr, 30rrr, 32rrr.
- — f. hercynica (A. Mayer) Hust. — 11rrr.
- dubium (Ehrenb.) Cleve — 3rrr, 4rrr, 5rrr, 6rrr, 24rrr, 25rrr, 28rrr, 30rrr, 32rrr.
- fasciatum Oestr. — 3rrr, 5rrr, 25rrr, 27rrr, 28rrr.
- iridis (Ehrenb.) Cleve — 2rrr, 5rrr, 9rrr, 11rr, 12rrr, 16rrr, 18rr.
- — var. amphigomphus (Ehrenb.) van Heurck — 10rrr, 32rrr.
- — var. ampliata (Ehrenb.) Cleve — 3rrr.
- — f. vernalis Reichelt — 1rrr, 4rrr, 6rrr, 7rrr, 11rrr, 13rrr, 14rrr, 18rrr, 25rrr.
- Diploneis elliptica (Kütz.) Cleve — 2rr, 6rr, 11rrr, 12rr, 14r, 15rr, 16rr, 20rr, 21rr, 24rr, 25rr, 27rrr, 32rrr.
- oculata (Bréb.) Cleve — 5rrr, 8rrr, 11rr.
- ovalis (Hilse) Cleve — 1rr, 2r, 3rrr, 4rr, 5rr, 6rr, 7rr, 8rrr, 9rrr, 10rr, 11rr, 12r, 13rr, 14rrr, 15r, 16r, 18r, 21rr, 22r, 24r, 25r, 27rrr, 30rrr, 32rrr.
- — var. oblongella (Näg.) Cleve — 1r, 2r—c, 3rrr, 4rrr, 5r—c, 7r—c, 8rr, 13r, 14rrr, 15r, 16r, 18rr, 21r—c, 24r, 25rr, 27r, 30r.
- puella (Schumann) Cleve — 1c—cc, 2c—cc, 3r, 4c—cc, 5r—c, 6r—c, 7c, 8rrr, 9rrr, 10r—c, 14rr, 15r, 16r, 21r—c, 23rrr, 24rr, 25rr, 30r.
- Stauroneis anceps Ehrenb. — 9rrr, 10rrr, 11r, 15rrr, 18rrr, 24rrr, 25rrr, 26rrr, 27rrr, 30rrr, 32rrr.
- phoenicenteron Ehrenb. — 3rrr, 5rrr, 8rrr, 9rrr, 10rrr, 22rrr, 24rrr, 25rr, 26rrr, 27rrr, 28rrr, 30rrr, 32rrr.
- Smithii Grun. — 4rrr, 5rrr, 24rrr, 28rrr, 30rrr.
- Anomoeoneis exilis (Kütz.) Cleve — 3rrr, 4rrr, 5rr, 7rr, 10rrr, 11r, 12rr, 13rrr, 14rrr, 15rrr, 16rr, 18r, 19rrr, 20r, 21rr, 22rrr, 24r, 25rr, 27rr.
- serians (Bréb.) Cleve var. brachysira (Bréb.) Hust. — 15rrr.
- — f. thermalis (Grun.) Hust. — 13rrr, 15rrr.
- styriaca (Grun.) Hust. — 18rrr.
- Navicula atomus (Näg.) Grun. — 10rrr.
- bacilliformis Grun. — 2rrr, 3rr, 4rr, 5rrr, 6rr, 7rrr, 9rr, 14rrr, 24rrr, 25rrr, 26rr, 27rrr, 30rrr.
- bacillum Ehrenb. — 2rrr, 3rr, 4rr, 5rrr, 6rr, 7rrr, 14rrr, 24rrr, 25rrr.
- cari Ehrenb. — 1r, 2r, 3rr, 4r, 5rr, 6rrr, 7rrr, 8rr, 9rrr, 10rr, 13rr, 14rr, 15rrr, 20rrr, 21rr, 23r, 24r, 25rr, 27rr, 29rr, 30r—c.
- cryptocephala Kütz. — 1c—cc, 2r—c, 3r, 4cc, 5r—c, 6cc, 7c—cc, 8r—c, 9r—c, 10ccc, 11c, 12c, 13r—c, 14r—c, 15r, 16c, 17rrr, 18ccc, 19c—cc, 20c—cc, 21r—c, 23r, 24r, 25c, 26ccc, 27r, 28c, 29rrr, 30rrr, 32rrr.
- — var. intermedia Grun. — 24rrr.
- — var. veneta (Kütz.) Grun. — 4c, 5rr, 7c, 11rrr, 15rr, 20r, 21r, 22rr, 23rr, 24rr, 25r, 27r.
- cuspidata Kütz. — 5rrr, 24rrr, 25rr, 28rrr, 30rrr.
- —var. ambigua (Ehrenb.) Cleve — 1rrr, 2rrr, 32rrr.
- dicephala (Ehrenb.) W. Smith — 7rrr, 21rrr, 24rrr, 25rrr, 27rrr, 28rrr, 30rr.
- exigua (Greg.) O. Müll. — 24rr, 25rrr.
- gracilis Ehrenb. — 5rrr, 10rrr, 11rrr, 14rrr, 21rr, 24rrr, 25rrr, 27r, 28rr, 29c, 30cc, 32rr.
- Grimmei Krasske — 5rrr.
- hassiaca Krasske — 18rrr.



- *hungarica* Grun. var. *capitata* (Ehrenb.) Cleve — 29rrr, 30rrr, 32rr.
- *lanceolata* (Ag.) Kütz. — 13rr, 15rrr, 24r, 25r.
- *menisculus* Schumann — 2rrr, 3rrr, 5rrr, 24rrr, 25rr.
- *minima* Grun. — 11rrr, 15rr, 30rr.
- — var. *atomoides* (Grun.) Cleve — 15r, 24rr.
- *oblonga* Kütz. — 3rrr, 5rrr, 6r, 7rr, 8rrr, 9rr, 10rrr, 11rr, 12r, 13r, 14rr, 15rr, 16rr, 19rr, 20rr, 21rrr, 24r, 25r, 26r, 30rrr, 32rrr.
- *placentula* (Ehrenb.) Grun. f. *rostrata* A. Mayer — 24rrr.
- *pupula* Kütz. — 1rrr, 4rrr, 5rrr, 7rrr, 10rrr, 11rrr, 14rrr, 15rr, 16rr, 24rr, 25rr, 26rrr, 28rrr, 30rr.
- — var. *aquaeductae* (Krasske) Hust. — 18rr.
- — var. *capitata* Hust. — 3rrr, 24rrr, 25rrr.
- *radiosa* Kütz. — 1r, 2r, 3rrr, 4r, 5r, 6r, 7r—c, 8r, 9r, 10r, 11r, 12c, 13r, 14r, 15r, 16r, 17rr, 18c, 19rrr, 20r—c, 21r, 22rr, 23rrr, 24r, 25r, 26c, 27rrr, 28rr, 29rrr, 30rrr, 31rrr, 32rrr.
- — var. *tenella* (Bréb.) Grun. — 5rr, 7r, 13rr, 14rrr, 15r, 20rrr, 24rr.
- *Reinhardtii* Grun. — 30rrr, 32rrr.
- *rhynchocephala* Kütz. — 24r, 25rr.
- *seminulum* Grun. — 15rrr, 16rrr.
- *subbacillum* Hust. — 2rr, 4rr, 5rrr, 7rrr, 11rr, 13rr, 14rrr, 15r, 20rrr, 24rr.
- *tuscula* (Ehrenb.) Grun. — 11rr, 12rrr, 15rr, 16rrr, 18rr, 22rrr, 24rr, 25rrr.
- — f. *minor* Hust. — 24rrr.
- *viridula* Kütz. forma — 24rrr, 27rrr, 28rrr, 29rrr, 32rrr.
- — var. *capitata* A. Mayer — 5rr.
- *vulpina* Kütz. — 3rrr, 10r, 21rrr.
- Pinnularia borealis* Ehrenb. — 21rrr.
- *divergens* W. Smith var. *elliptica* Grun. — 5rrr.
- *gibba* Ehrenb. var. *linearis* Hust. — 18rrr.
- *gracillima* Greg. — 8rrr, 15rr, 16rr, 18rr, 22rrr.
- *interrupta* W. Smith — 24rrr, 25rrr, 30rr, 32rrr.
- *maior* (Kütz.) Cleve — 1rrr, 3rrr, 4rrr, 6rrr, 7rrr, 8rrr, 9rrr, 10rrr, 11rr, 12rr, 13rr, 14rrr, 15rr, 16rr, 18rr, 22rrr, 24rrr, 25rrr, 26rrr, 27rrr.
- — f. *hyalina* Hust. — 5rrr, 25rrr.
- — var. *linearis* Cleve — 30rr.
- — var. *paludosa* Meist. — 24rrr.
- *mesolepta* (Ehrb.) W. Smith — 5rrr, 28rrr, 29rrr, 30rr.
- *microstauron* (Ehrenb.) Cleve — 2rrr, 5rrr, 7rrr, 8rrr, 11rrr, 30rrr.
- — var. *Brebissonii* (Kütz.) Hust. — 7rrr, 24rrr, 25rrr, 30rrr.
- *subsolaris* (Grun.) Cleve — 18rr.
- *viridis* (Nitzsch) Ehrenb. — 2rrr, 8rrr, 9rrr, 11rrr, 18rrr, 19rrr, 24rrr, 25rrr, 27rrr, 30rrr.
- — var. *fallax* Cleve — 15rrr, 22rr.
- — var. *sudetica* (Hilse) Hust. u. formae — 11rrr, 13rrr, 15rrr, 21rrr, 22rrr, 24rrr.
- Amphora ovalis* Kütz. — 2rr, 3rrr, 4rrr, 5rrr, 6rrr, 7rrr, 8rrr, 9rrr, 15rrr, 19rrr, 21rrr, 24rr, 25rr, 26rrr, 27rrr, 28rrr, 29rrr, 30rr, 32rrr.
- — f. *gracilis* (Ehrenb.) Cleve — 16rrr.
- — var. *libyca* (Ehrenb.) Cleve — 2rr, 3rr, 4c, 5rrr, 6rrr, 7rr, 8rrr, 9rrr, 10rr, 13rrr, 14rrr, 15rrr, 24rr, 25rr, 30rr, 32rrr.
- — var. *pediculus* Kütz. — 2r, 3rr, 4rrr, 5rr, 6r, 7c, 8rrr, 9rrr, 10rrr, 13rr, 15rrr, 16r, 21rr, 24r, 25rr, 30rr.
- Cymbella affinis* Kütz. — 1rr, 2rr, 3rr, 4rr, 5rr, 6rr, 7r, 10rrr, 11c, 12rr, 13r, 14rr, 15rrr, 16rrr, 20rrr, 24rrr, 28rrr, 29rr.
- *amphicephala* Näg. — 1rr, 7rr, 8r, 15r, 16r, 21rr, 23rrr, 24r, 25r, 30r, 32rrr.

- *aspera* (Ehrenb.) Cleve — 2rrr, 3rrr, 4r, 5rrr, 6rrr, 7rrr, 8rr, 9rrr, 11r, 14rrr, 15rrr, 16rrr, 17rrr, 21rrr, 22rrr, 25rrr, 26rrr, 27rrr, 30rrr.
- *austriaca* Grun. — 1rrr, 2rr, 5rrr, 9rrr, 11rr, 12c—cc, 13r, 14cc, 20rrr.
- *Cesati* (Rabenh.) Grun. — 1rr, 2r, 3r, 4c, 5rrr, 6c—cc, 7r, 8r, 10rr, 11r, 12c, 13cc, 14c, 15r, 16r—c, 18r, 19cc, 20c—cc, 21r, 22c, 24c, 25r, 28r.
- *cistula* (Hempr.) Grun. — 1rrr, 2rrr, 3rrr, 4rr, 5rrr, 6rr, 7rrr, 11rrr, 13r, 14rrr, 15r, 16rr, 24r—c, 25r.
- *cymbiformis* (Kütz.) van Heurck — 1rr, 2c—cc, 4rr, 5rrr, 6rr, 7r—c, 9rrr, 10rrr, 11cc, 12rr, 13r, 14rr, 17rrr, 18rrr, 19rrr, 20rr, 21rrr, 24rr, 25r, 26rr, 29rrr, 30rr, 32rrr.
- *delicatula* Kütz. — 2r, 3rrr, 4r, 5rr, 6c—cc, 7r, 11r, 12c—cc, 13c, 14cc, 15r, 16r, 20rr, 24r, 25r—c, 28rrr.
- *Ehrenbergii* Kütz. — 5rrr, 24rr, 25rr, 30rrr, 32rrr.
- *gracilis* (Rabenh.) Cleve — 18r.
- *helvetica* Kütz. — 1r—c, 2c, 3r, 4cc, 5rr, 6r—c, 7r, 10rr, 11r, 12c, 13c, 14r—c, 15rr, 16rrr, 18rrr, 20rr, 21rr, 24r, 25rr, 32rrr.
- *laevis* Näg. — 2rr, 4c, 6r—c, 8r—c, 9rr, 10rrr, 14rrr, 15rr, 16r, 20rr, 24rr, 25rr, 29rr, 30rrr.
- *lanceolata* (Ehrenb.) van Heurck — 3rrr, 4rrr, 6rrr, 7rrr, 8rrr, 10rrr, 12rrr, 13rrr, 17rrr, 24rrr, 25rr, 27rrr, 30rrr, 32rrr.
- *leptoceros* (Ehrenb.?) Grun. — 24rrr.
- *microcephala* Grun. — 1r, 2r, 3rrr, 4r, 5rr, 6r—c, 7r, 9rr, 10rr, 11r, 12r, 13c—cc, 14c—cc, 15c—cc, 16c, 18cc, 21r, 23rr, 24c, 25cc, 27rrr, 28rr.
- — *f. robusta* Hust. — 4c, 11rr, 20r—c.
- *naviculiformis* Auersw. — 4rr, 10rrr, 24rrr, 26rrr, 27rr, 28rr, 30rrr, 32rrr.
- *norvegica* Grun. — 20r.
- *obtusa* Greg. — 3rrr, 4rrr, 5rrr, 6rr, 7rrr, 8rrr, 11rr, 12c, 13r, 14rr, 15r, 16r, 18cc, 19r—c, 20c, 21rr, 22rr, 24rrr, 25rr, 26rrr, 30rrr, 32rrr.
- *obtusiuscula* (Kütz.) Grun. — 6r, 7rrr, 8rr, 11rr, 15rrr, 16rrr, 23rrr.
- *parva* (W. Smith) Cleve — 3rr, 11rrr, 20rrr, 21rrr, 24rrr, 30rr.
- *perpusilla* A. Cleve — 21rr.
- *prostrata* (Berkeley) Cleve — 28rrr, 30rrr.
- *similis* Krasske — 5rrr.
- *sinuata* Greg. — 7rrr, 15rrr.
- — *f. ovata* Hust. — 7rrr, 13rrr.
- *tumidula* Grun. — 1c—cc, 2rr, 3rr, 4r, 5r, 6r, 7r, 8r, 11rrr, 13cc, 14r—c, 15c, 16r—c, 21r—c, 23rr, 24rr, 25r—c, 28rrr, 30r—c.
- *ventricosa* Kütz. — 1c—cc, 2r, 3rrr, 4c—cc, 5rr, 6r—c, 7rr, 8r, 9rrr, 10rrr, 18rr, 21rr, 24r, 28rr, 29rrr, 30c, 32rrr.
- Gomphonema acuminatum* Ehrenb. — 3rr, 4rrr, 5rrr, 6rrr, 7rrr, 8rrr, 9rrr, 10rrr, 12rrr, 17rrr, 24rrr, 25rrr, 26r, 27rrr, 28rrr, 30rrr.
- — *var. Brebissonii* (Kütz.) Cleve — 1rrr, 4rrr.
- — *var. coronatum* (Ehrenb.) W. Smith — 1 rr, 2r, 3rrr, 4rr, 6rr, 7rrr, 8rrr, 9rrr, 15rrr, 16rr, 21r, 24rrr, 27rrr, 30rrr.
- *angustatum* (Kütz.) Rabenh. — 4r, 5rrr, 13rrr, 24rr, 27rr.
- *constrictum* Ehrenb. — 1rr, 2rr, 3r, 4r, 5rrr, 6rrr, 7rr, 8rr, 9rrr, 11rr, 12rrr, 13rr, 14rrr, 15rrr, 16rrr, 17rrr, 19rr, 20rrr, 21rr, 24rr, 25rrr, 26r, 27rrr, 28rr, 30rrr, 32rrr.
- *gracile* Ehrenb. — 2rr, 3rrr, 7rrr, 8r, 11r—c, 13rr, 24rr.
- — *var. cymbelloides* Grun. — 13rrr, 16rrr, 18rr, 19r.
- — *var. dichotomum* Cleve — 12rr, 21rrr.
- *intricatum* Kütz. — 4rrr, 11rrr, 13rrr, 14rrr, 16rr, 21rrr, 24r, 25r.
- — *var. pumilum* Grun. — 3rrr, 4rr, 5rrr, 6rr, 7rr, 10rrr, 11r, 13r, 14r, 15rr, 16r, 19r, 20rrr, 21rrr, 24r—c, 25cc, 29rrr, 32rr.

- lanceolatum Ehrenb. — 2rrr, 3rr, 4rr, 5rrr, 7rrr, 8r, 11r, 13rr, 14rr, 15rrr, 21rr, 22rrr, 24r, 25rr, 27r, 30rrr, 31rr.
- —var. insignis (Greg.) Cleve — 11r—c.
- longiceps Ehrenb. — 11rrr, 20rrr, 21rrr.
- —var. montanum (Schum.) Cleve — 2rrr, 4rrr, 11rrr, 13rrr, 21rr, 27rrr.
- — var. subclavatum Grun. — 11rr, 12rr, 13r.
- — f. gracilis Hust. — 12r, 20rrr.
- olivaceum (Lyngb.) Kütz. — 8rr, 25rr.
- parvulum (Kütz.) Grun. — 1r, 2r, 4rr, 5rr, 8r, 10rrr, 22rr, 23rrr, 25rrr, 27rr, 28r—c, 29r, 30rr, 31rr.
- —var. exilissimum Grun. — 3rrr, 4r, 5r, 7rr, 9rr, 14rr, 21r—c.
- — var. micropus (Kütz.) Cleve — 3rrr, 4r—c, 6r—c, 7c, 8c, 10rr, 13rr, 14rr, 15r—c, 16rr, 21r, 23r—c, 25rr, 26c, 28r—c, 30ccc, 32r.
- subtile Ehrenb. — 19rrr.
- Denticula elegans Kütz. — 2rr, 3rrr, 4rr, 7rrr, 12rrr, 13r—c, 14r, 16r, 18rr, 24r.
- tenuis Kütz. — 3rr, 5r, 9rr, 19rrr, 25r, 28rrr.
- — var. crassula (Näg.) Hust. — 1r, 2c, 3rr, 4r, 5rr, 6r, 7r, 8rr, 9rrr, 10rr, 11rr, 12r, 13r, 14rr, 15rrr, 25r, 27rrr, 30rrr.
- Epithemia argus Kütz. — 1rrr, 2rrr, 4rr, 6rrr, 8rrr, 11r, 13rr, 14r, 16r, 19rrr, 20rrr, 21rrr, 22rrr.
- — var. alpestris Grun. — 9rrr, 12rrr.
- Muelleri Fricke — 1rrr, 5rrr, 6rr, 7rrr, 8rrr, 12r—c, 13r, 14r, 18rr, 22rrr.
- zebra (Ehrenb.) Kütz. — 16rrr, 25rrr.
- — var. porcellus (Kütz.) Grun. — 11rr, 13rr, 16rr, 19rrr.
- — var. saxonica (Kütz.) Grun. — 4rrr, 18r.
- Rhopalodia gibba (Ehrenb.) O. Müll. — 1rrr, 2rrr, 11rr, 12r, 13rr, 14rrr, 15rrr, 16rrr, 18r—c, 19rrr, 20rr, 21rrr, 22rr, 24rrr, 25rrr.
- parallela (Grun.) O. Müll. — 4rrr, 11rr, 13rrr, 16rr, 18r, 20rrr, 22rr.
- Hantzschia amphioxys (Ehrenb.) Grun. — 1rrr, 5rrr, 6rrr, 8rrr, 9rrr, 12rrr, 14rrr, 25rrr, 28rrr.
- Nitzschia acicularis W. Smith — 3rrr, 5rrr, 7rrr, 8rrr, 9rrr, 10rrr, 24rrr, 27rr, 28rr, 30rr, 31rrr, 32rr.
- acula Hantzsch — 1rrr, 2rrr, 14r.
- amphibia Grun. — 2rrr, 4rrr, 7rrr, 11rrr, 15rr, 21rr, 30rrr.
- angustata (W. Smith) Grun. — 1rrr, 2rrr, 3rrr, 4rrr, 5rrr, 6rrr, 7rrr, 9rrr, 10rrr, 11rrr, 12rrr, 14rrr, 24r, 25r, 30rrr, 30rrr, 32rrr.
- — var. acuta Grun. — 15rrr, 16rrr, 25rr.
- communis Rabenh. — 5rrr.
- denticula Grun. — 5rr, 6r, 7r, 13rrr, 14rrr, 15r, 19rrr, 24r, 27rr, 28rrr, 29rrr, 30rrr.
- dissipata (Kütz.) Grun. — 4rrr, 5r, 21rrr, 24rrr.
- fonticola Grun. — 3rrr, 4rrr, 5rrr, 7rr, 15rrr, 24rrr, 25rrr.
- gracilis Hantzsch — 24rrr.
- Hantzschiana Rabenh. — 11rrr, 30rr.
- Kuetszingiana Hilse — 7rr, 11rrr, 24rr.
- linearis W. Smith — 1rrr, 2rrr, 3rr, 4rr, 5r, 7rr, 8rr, 9rrr, 10r, 11r, 12rrr, 14r, 16rr, 18rrr, 20rrr, 23rr, 24r, 25rr, 26rrr, 27r, 28r, 29rrr, 30cc, 32r—c.
- palea (Kütz.) W. Smith — 1rrr, 2rr, 3rr, 4r, 6r—c, 7rr, 8rrr, 9rr, 10cc, 11r, 13rrr, 14r, 15r, 16r, 21rr, 22rr, 24rr, 25r, 28r—c, 29r, 30rr, 32r.
- — var. tenuirostris Grun. — 32r.
- perminuta Grun. — 13rrr, 18r—c.
- radícula Hust. forma — 18rrr.
- recta Hantzsch — 11rr, 13rrr, 24r, 32rrr.
- romana Grun. — 14rrr.



- sigmoidea (Ehrenb.) W. Smith — 5rrr, 8rrr, 10rrr, 11rrr, 12rrr, 13rrr, 14rr, 15rrr, 16rr, 24rr, 25rr, 26rrr, 27rrr, 28rr, 32rrr.
- sinuata (W. Smith) Grun. — 2rrr, 13rrr, 21rr, 22rrr.
- vermicularis (Kütz.) Grun. — 25rr, 28r, 29rrr, 30r—c, 32r.
- Cymatopleura elliptica* (Bréb.) W. Smith — 5rrr, 11rrr, 16rrr, 28rrr, 30rrr, 32rrr.
- solea (Bréb.) W. Smith — 1rrr, 2rrr, 5rrr, 10rrr, 16rrr, 24rrr, 25rrr, 28rrr.
- Surirella angusta* Kütz. — 5rrr, 8rrr, 10rrr, 21rrr, 24rrr, 27rrr, 28rrr, 32rrr.
- biseriata Bréb. — 5rrr, 32rrr.
- linearis W. Smith — 8rrr, 27rrr.
- var. constricta (Ehrenb.) Grun. — 26rrr.
- ovata Kütz. — 5rrr, 8rrr, 32rrr.
- var. pinnata (W. Smith) Hust. — 8rrr, 24rrr.
- spiralis Kütz. — 5rrr, 7rrr, 25rrr, 30rr.
- Campylodiscus noricus* Ehrenb. — 2rrr, 5rrr, 6rrr, 7rrr, 8rrr, 9rrr, 10rrr, 27rrr, 28rrr, 32rrr.
- var. hibernicus (Ehrenb.) Grun. — 14rrr, 30rrr.

## CHLOROPHYCEAE

### A. CHLOROPHYCEAE s. str.

- Pandorina Morum* Bory — 15rrr, 16rr, 17rrr, 19rr.
- Asterococcus superbus* (Cienk.) Scherffel — 22rrr.
- Gloeocystis ampla* Kütz. — 18rr.
- vesiculosa Näg. — 13rrr.
- Tetraspora lubrica* (Roth) Ag. — 32c.
- Pediastrum Boryanum* (Turp.) Menegh. — 5rrr, 8rrr, 17rrr, 24rrr, 25rrr, 28rrr, 30rrr.
- *Pearsoni* G. S. West var. *orientale* Skuja — 1rrr, 2rrr, 3rrr, 4rrr, 5rrr, 6rrr, 7rr, 8rrr, 9rrr, 10rrr, 11rrr, 13rrr, 14rrr, 15rr, 16rrr, 19rrr, 24rrr.
- Oocystis irregularis* (Petkoff) Printz — 12rrr.
- *solitaria* Witttr. — 1rrr, 2rrr, 4rrr, 6rrr, 8rrr, 12rr, 14rrr, 15rrr, 16rr, 18r, 19rrr, 22rrr.
- Nephrocytium Agardhianum* Näg. — 4r, 12rrr, 16rr, 18rrr.
- *obesum* West — 11rrr, 13rrr, 14rrr, 15rrr, 19rrr.
- Tetraëdron minimum* (A. Br.) Hansg. — 16rrr.
- Ankistrodesmus biplex* (Reinsch) G. S. West — 12rrr, 14rr, 15rr, 16rr, 19rr.
- *Braunii* (Näg.) Collins — 27rrr, 28rr, 32rr.
- *falcatus* (Corda) Ralfs — 1r, 2rrr, 4r, 5rr, 6r, 7rrr, 8rrr, 9rrr, 14rr, 16rrr, 17rrr, 18r, 20rr, 21rr, 24rr, 25rrr, 27rrr, 28r, 29r, 30rr, 32rrr.
- var. *radiatus* (Chod.) Lemm. — 1rrr, 4rrr, 6r, 11rrr, 16rrr.
- var. *spirilliformis* G. S. West — 2rrr, 4rrr, 6r, 11rrr, 16rrr.
- spec. — 31rrr.
- *spiralis* (Turn.) Lemm. — 25rrr.
- Scenedesmus acutiformis* Schröd. — 1rrr.
- *acutus* Meyen — 1rrr, 14rrr, 28rrr.
- *armatus* Chod. — 24rrr, 28rrr.
- var. *bicaudatus* (Guglielmetti — Printz) Chod. — 6rrr, 9rrr.
- *ecornis* (Ralfs) Chod. — 6rr, 10rrr, 12rrr, 15rr, 16r, 17rrr, 18rrr, 19rr, 25rr, 28r.
- var. *disciformis* Chod. — 16rrr, 25rrr.
- *intermedius* Chod. — 16rrr.
- *microspina* Chod. — 8rrr, 14rrr.
- *ovalternus* Chod. — 1rrr, 14rrr, 18rrr, 19rrr.

- quadricauda (Turp.) Bréb. — 5rrr, 9rrr, 24rr, 25rrr, 28rrr, 29r—c, 30rrr.
- quadrispina Chod. — 17rrr, 31r.
- tenuispina Chod. — 24rr.
- Westii (G. M. Smith) Chod. — 6rrr, 7rrr, 10rrr, 11rrr, 24rr, 30rrr.
- Crucigenia rectangularis* (A. Br.) Gay — 17rrr.
- Coelastrum cubicum* Näg. — 2rrr, 6rrr, 13rrr.
- microporum Näg. — 5rrr, 30rrr.
- proboscideum Bohlin — 2rrr, 6rrr, 16rrr, 18rrr.
- Microspora amoena* (Kütz.) Rabenh. — 1ccc.
- Loeffgreni (Nordst.) Lagerh. — 2c.
- pachyderma (Wille) Lagerh. — 7r, 8cc, 23r, 27ccc, 32rrr.
- quadrata Hazen — 23r—c.
- stagnorum (Kütz.) Lagerh. — 6rr, 8ccc, 27cc.
- tumidula Hazen — 6rr.
- Willeana Lagerh. — 1rr, 4r.
- Chaetophora elegans* (Roth) Ag. — 10ccc, 11rrr, 24cc, 25rrr.
- var. *pachyderma* (Witr.) Schmidle — 31c.
- Aphanochaete repens* A. Br. — 2rrr.
- Oedogonium spec. steril.* — 4rr, 6rr, 8rrr, 12rrr, 18r, 19rr, 30r.
- Bulbochaete spec. steril.* — 4rr, 11r, 12rrr, 13rr, 14rrr, 16rr, 18rrr, 19rrr, 20rr, 21rr, 22rrr, 25r—c.
- Cladophora fracta* Kütz. ampl. Brand var. *lacustris* (Kütz.) Brand „status simplex” — 1c, 2ccc.
- Vaucheria clavata* (Vauch.) DC. — 32ccc.

## B. CONJUGATAE

### 1. Zygnemales

- Mougeotia spec. steril.* — 4rrr, 8r, 11r, 15rr, 16c, 19rrr, 20r, 21r, 22r—c, 23ccc, 25rrr, 27r.
- Zygnema spec. steril.* — 3ccc, 4rrr, 5ccc, 11r, 12rr, 15r, 16r—c, 17ccc, 18rr, 19c, 27r.
- Spirogyra spec. steril.* — 4rr, 5rrr, 11r, 13r—c, 14rrr, 15r, 16r, 18r, 19c, 20r, 21r, 22r, 23rr, 26ccc.

### 2. Desmidiáles

- Netrium Digitus* (Ehrenb.) Itzigs. et Rothe — 4rrr, 11rr, 14rrr, 16rrr.
- var. *lamellosum* (Bréb.) Grönb. — 12rrr.
- Penium rufescens* Cleve — 21rrr.
- Closterium acutum* Bréb. — 5rrr, 6rrr, 7rrr, 17rrr, 19rrr, 30rrr, 32rrr.
- *dianae* Ehrenb. — 12rrr, 18r.
- *Ehrenbergii* Menegh. — 13rrr.
- *idiosporum* W. u. G. S. West — 1rrr, 16rr.
- *malinvernianiforme* Grönb. — 1rr, 11rrr, 13rrr.
- *moniliferum* (Bory) Ehrenb. — 21rrr.
- *parvulum* Näg. — 1r, 4rr, 5rr, 11r, 12rrr, 13rr, 14rrr, 15rrr, 16r, 17rrr, 18rr, 19r, 20rr, 22r, 23rrr, 26rrr, 27rr, 28rrr, 29rr, 30r, 32rrr.
- va. *maius* West — 13rrr, 25rrr.
- *Pritchardianum* Arch. — 26rrr.
- *prorum* Bréb. — 14rrr, 20rr.
- *pseudolunula* Borge — 8rrr, 11rrr.
- *rostratum* Ehrenb. — 1rrr, 6rrr, 11r, 13rrr.
- *strigosum* Bréb. — 20rrr.
- var. *elegans* (G. S. West) Krieg. — 21rr.
- *subulatum* (Kütz.) Bréb. — 27rr.
- var. *maius* Krieg. — 14rrr, 20rrr, 23rrr, 27rrr.
- Pleurotaenium Ehrenbergii* (Bréb.) de Bary — 14rrr, 16rrr, 18rrr, 22rrr.
- *Trabecula* (Ehrenb.) Näg. — 13rrr, 14rrr, 18rr, 19rrr, 20rrr.
- var. *crassum* Witr. — 22rrr.

- — var. maximum (Reinsch) Roll — 11r, 22rrr.
- Euastrum bidentatum Näg. — 18rrr.
- insulare (Wittr.) Roy — 18rrr.
- Micrasterias Crux-Melitensis (Ehrenb.) Hass. — 11rrr, 18rrr, 22rrr.
- truncata (Corda) Bréb. — 18rrr.
- Cosmarium anceps Lund. — 2rrr, 21r, 27rrr.
- — forma — 18rrr.
- bioculatum Bréb. forma — 5rrr, 6rrr, 21rrr, 27rrr, 28rrr.
- Botrytis Menegh. — 2rrr, 28rrr.
- — var. paxillosporum W. u. G. S. West — 13rrr, 14rrr, 15rrr, 16rrr, 18r, 19r.
- Braunii Reinsch var. Pseudoregnellii Messik. — 1rrr, 2rrr, 4rr, 19rrr.
- connatum Bréb. — 18rr.
- contractum Kirchn. var. ellipsoideum (Elfv.) W. u. G. S. West — 19r—c, 20rrr.
- crenatum Ralfs — 1rrr, 8rrr, 11rrr, 21rrr.
- crenulatum Näg. — 3rrr, 6rr, 7rrr, 12rrr, 14rrr, 21r, 23rr, 25rrr, 27rrr, 28r.
- — var. tumidulum Insam u. Krieg — 2rr, 4rr, 6rr, 13rrr, 32rrr.
- cruciferum de Bary — 16rrr.
- cucurbitinum (Biss.) Lütkem. — 23rrr.
- cymatopleurum Nordst. — 11rr, 21rrr, 22rrr.
- Debaryi Arch. — 18rrr, 22rrr.
- depressum (Näg.) Lund. — 22rrr.
- — var. achondrum (Boldt) W. u. G. S. West — 18rrr.
- didymochondrum Nordst. — 1rrr, 8rrr, 13rrr, 14rrr, 16rrr, 20rrr, 22rrr, 27rrr.
- difficile Lütkem. — 1rrr, 2rrr, 3rrr, 4rr, 11rr, 18r, 19rr, 20rr, 22rrr.
- furcatospermum W. u. G. S. West forma — 21r—c.
- globosum Bulnh. forma — 18rrr, 19rrr.
- granatum Bréb. — 1rrr, 2rrr, 4rr, 5rrr, 6rrr, 11rr, 12rr, 13r, 14rrr, 15rrr, 16r, 18r, 19rr, 20rrr, 21rr, 22rrr, 25rrr, 27rr, 28rr.
- — var. subgranatum Nordst. — 2rrr, 4rrr, 5rrr.
- holmiense Lund. var. integrum Lund. — 22rrr.
- — f. constricta Gutw. — 1rrr, 2rrr, 8rrr, 11rrr, 18rrr, 20rrr, 21r, 22rrr, 23rr, 27rrr.
- impressulum Elfv. — 3rrr, 7rrr, 8rrr, 9rrr, 10rrr, 14rrr, 16rrr, 18rrr, 19rr, 21rrr, 28r, 30rrr, 32rrr.
- — f. Reinschii Istv. — 15rrr.
- laeve Rabenh. — 1r, 3rrr, 4rrr, 5rrr, 6rrr, 7rrr, 12rrr, 14rrr, 15rrr, 16rr, 19r, 20rr, 22rrr, 25rrr, 27rrr, 28r, 30r.
- margaritatum (Lund.) Roy et Biss. — 11rr, 13rrr, 14rrr, 16rrr, 18rr, 19rrr, 22rrr, 25rrr.
- minimum W. u. G. S. West var. rotundatum Messik. — 4rrr, 14rrr, 19rrr.
- obtusatum Schmidle — 1r, 2rr, 11r, 19rrr, 22rrr.
- ochthodes Nordst. — 1rrr, 4rrr, 12r, 14rr, 18rrr.
- — var. aequale Insam u. Krieg. — 14rrr.
- — var. amoebum W. West — 18rr.
- pachydermum Lund. — 11rr, 13rrr, 19rrr, 22rrr.
- Pokornyanum (Grun.) W. u. G. S. West — 1rr, 2rrr, 5rrr, 8rr, 11r, 14rrr, 16rrr, 18rr, 21r, 22rrr, 27rrr.
- praecisum Borge — 4rr, 6rrr.
- punctulatum Bréb. — 3rrr, 4r, 6rrr, 11rrr, 15rrr, 17rrr, 19rrr, 21rr, 25rrr, 28r—c, 30rrr.
- — var. subpunctulatum (Nordst.) Börges. — 5rrr, 12rrr.
- quadratum Ralfs — 1rrr, 11rrr, 18rr, 22rrr.
- — f. Willei W. u. G. S. West — 2rrr.
- rectangulare Grun. — 18r.



- reniforme (Ralfs) Arch. — 12rrr, 14rrr.
- speciosum Lund. — 1rrr, 8rrr, 18rrr, 21r, 22rr, 27rrr.
- — var. biforme Nordst. — 21r, 23rrr.
- — var. simplex Nordst. — 19rrr.
- subcrenatum Hantzsch — 6rrr, 7rrr, 8rr, 9rrr, 11rrr, 12rrr, 13rrr, 16rrr, 19rr, 21rrr, 23rr, 27rrr, 30rrr.
- Subreinschii Schmidle var. latum Messik. — 18 r.
- subspeciosum Nordst. var. transiens Messik. — 8rrr.
- subtumidum Nordst. — 18r.
- — var. Klebsii (Gutw.) W. u. G. S. West — 19rrr.
- tetraophthalmum Bréb. — 2rrr, 4rr, 5rrr, 6rrr, 8rrr, 11r—c, 13r, 14rrr, 16rrr, 19rrr, 20rrr, 21rr, 22rrr, 25rrr.
- turgidum Bréb. — 14rrr, 18rr, 19rrr.
- vexatum West — 1rr, 3rrr, 4r, 5rrr, 6rrr, 8rrr, 11r, 15rr, 17rrr, 19rr, 22rrr, 27rrr, 28r, 30r.
- — var. lacustre Messik. — 2rrr, 10rrr, 21r, 23rrr, 25rrr.
- Staurastrum alternans Bréb. — 4rrr, 6rrr, 12rrr, 14rrr, 16rrr, 18rr, 19r—c, 25rrr, 28rrr.
- apiculatum Bréb. forma — 19r.
- Bieneanum Rabenh. — 24rrr.
- — var. ellipticum Wille — 25rrr.
- dejectum Bréb. var. patens Nordst. — 16rrr, 28rrr.
- dispar Bréb. — 1r, 5rr, 8rr, 9rrr, 21r, 25rrr, 27rrr, 32rrr.
- furcatum (Ehrenb.) Bréb. var. candianum (Delp.) Cooke — 18rrr.
- granulosum (Ehrenb.) Ralfs — 18rr.
- hexacerum (Ehrenb.) Witt. — 18r—c, 28rrr.
- — var. productum Hodgetts — 30rrr.
- inflexum Bréb. — 15rrr, 24rrr.
- lapponicum (Schmidle) Grönbl. — 16rrr.
- muticum Bréb. — 28rrr.
- polymorphum Bréb. — 18r, 25rrr.
- punctulatum Bréb. — 5rrr, 6rr, 7rrr, 8r, 9rrr, 10rrr, 12rrr, 15rrr, 16rrr, 18rr, 20rr, 28rrr.
- — var. pygmaeum (Bréb.) W. u. G. S. West — 14rrr.
- — var. subproductum W. u. G. S. West — 1rrr.
- Gonatozygon monotaenium de Bary — 1rrr, 27rrr.
- Spondylosium Lundellii Borge var. triquetrum W. u. G. S. West — 16rrr.
- Hyalotheca dissiliens (Sm.) Bréb. — 2rrr, 4rrr, 11r, 13rrr, 15rrr, 16rrr, 17rrr, 18rr, 19rrr, 20rr.

#### RHODOPHYCEAE

Batrachospermum moniliforme Roth — 10ccc, 2r, 24cc.

#### CHAROPHYCEAE

Chara foetida A. Br. — 11r—c, 25c.  
 — fragilis Desv. — 18r, 19c, 25r.

#### FUNGI

Asterothrix raphidioides (Reinsch) Printz — 5rrr.  
 Olpidium Cosmarii sp. nov.

### 3. Übersicht und Gruppenstatistik

a) Übersicht bezogen auf die Probengesamtheit

Algenklassen	Anzahl der Arten und Varietäten	%-werte	Algenklassen	Anzahl der Arten und Varietäten	%-werte
Cyanophyceae	45	9,11	Chlorophyceae		
Chrysophyceae	4	0,81	s. str.	50	10,12
Flagellophyceae	20	4,04	Zygnemales	3	0,61
Dinophyceae	8	1,62	Desmidiales	103	20,85
Xanthophyceae	4	0,81	Rhodophyceae	1	0,20
Bacillariophyceae	255	51,42	Charophyceae	2	0,40
			Totaal	494	100,00

b) Übersicht bezogen auf extreme Proben

	Prob.	Nr. 24	Prob.	Nr. 18	Prob.	Nr. 26
	Anz.	%	Anz.	%	Anz.	%
Cyanophyceae	2	1,31	21	16,67	1	2,33
Chrysophyceae	—	—	—	—	—	—
Flagellophyceae	1	0,65	6	4,76	8	18,60
Dinophyceae	—	—	2	1,59	—	—
Xanthophyceae	—	—	—	—	1	2,33
Bacillariophyceae	139	90,85	48	38,10	30	69,76
Chlorophyceae	8	5,23	9	7,14	—	—
s. str.						
Zygnemales	2	—	2	1,59	1	2,33
Desmidiales	2	1,31	37	29,36	2	4,65
Rhodophyceae	1	0,65	1	0,79	—	—
Charophyceae	—	—	—	—	—	—
Total	159	100,00	126	100,000	43	100,00

c) Gruppenstatistik der Bacillariophyceae

Gattungen	absol. Vertr.	relat. Vertr. %	Gattungen	absol. Vertr.	relat. Vertr. %
Melosira	3	1,18	Neidium	9	3,53
Cyclotella	6	2,31	Diploneis	5	1,96
Tabellaria	2	0,78	Stauroneis	3	1,18
Diatoma	6	2,35	Anomoeoneis	4	1,57
Meridion	1	0,39	Navicula	35	13,72
Ceratoneis	—	—	Pinnularia	15	5,88
Fragilaria	11	4,31	Amphora	4	1,57
Synedra	13	5,10	Cymbella	28	10,98
Eunotia	11	4,31	Gomphonema	21	8,24
Cocconeis	6	2,35	Denticula	3	1,18
Achnanthes	15	5,88	Epithemina	6	2,35
Rhoicosphenia	1	0,39	Rhopalodia	2	0,78
Mastogloia	1	0,39	Hantzschia	1	0,40
Amphipleura	1	0,40	Nitzschia	22	8,63
Frustulia	1	0,40	Cymatopleura	2	0,78
Gyrosigma	1	0,40	Surirella	7	2,74
Caloneis	7	2,75	Campylodiscus	2	0,78
			Total	255	100,00

# d) Gruppenstatistik der Desmidiáles

Gattungen	absol. Vertr.	relat. Vertr. %	Gattungen	absol. Vertr.	relat. Vertr. %
<i>Cylindrocystis</i>	—	—	<i>Micrasterias</i>	2	1,94
<i>Netrium</i>	2	1,94	<i>Cosmarium</i>	55	53,40
<i>Penium</i>	1	0,97	<i>Xanthidium</i>	—	—
<i>Closterium</i>	16	15,53	<i>Arthrodesmus</i>	—	—
<i>Pleurotaenium</i>	4	3,89	<i>Staurastrum</i>	18	17,48
<i>Tetmemorus</i>	—	—	<i>Nematogene</i>	—	—
<i>Euastrum</i>	2	1,94	<i>Desmidiaceen</i>	3	2,91
			Total	103	100,00

Im Anschlusse an das mitgeteilte statistische Zahlenmaterial mögen einige Erläuterungen am Platze sein. Die Gesamtübersicht der Algenklassenvertretungen im Gebiet lässt erkennen, dass gegenüber den allgemeinen Verbreitungsverhältnissen in Mitteleuropa kein Gleichgewichtszustand besteht. Eine Übereinstimmung ist auch kaum zu erwarten, da ein einzelnes Untersuchungsgebiet in den seltensten Fällen die grosse Mannigfaltigkeit der Standortverhältnisse eines ausgedehnten Gebietes auf sich zu vereinigen vermag, sondern in der Regel stärker individuelle Züge aufweist. Im Hinblick auf die massgebenden Standortsfaktoren ist unser Gebiet durch drei hervorstechende Eigentümlichkeiten gekennzeichnet, nämlich durch den Kalkreichtum, die relative Kühleit und in der Mehrzahl der Fälle auch die Bewegtheit seines Wassers. Unter Berücksichtigung diese Gegebenheiten mag es uns verständlich erscheinen, warum die *Diatomeen* in allen Proben, und zwar mit wenigen Ausnahmen, sehr stark dominieren, dass auch die *Cyanophyceen* etwas überrepräsentiert erscheinen, indes die *Desmidiaceen* und *Flagellaten*, die zu ihrem Gedeihen mehr höher temperiertes und stehendes Wasser benötigen, eine viel zu schwache Vertretung aufweisen.

Bei dem Durchgehen der Extremfälle (b-Übersicht) stösst man auf keine hochgradigen Abweichungen von den mittleren Verhältnissen. Dies hängt damit zusammen, dass der Milieu-Faktorenkomplex bis zu einem gewissen Grade durch Ausgeglichenheit gekennzeichnet ist; an keiner einzigen Stelle im Gebiet kommt neben dem harten auch weiches Wasser vor, dann ist der Humussäuregehalt des Wassers durchwegs niedrig. Indessen fehlt es aber doch nicht ganz an Inhomogenitäten. Hydromechanisch kann unterschieden werden zwischen rasch- und schwachbewegtem und in wenigen Fällen auch stagnierendem Wasser. Das Wasser ist über das Jahr an den meisten Entnahmestellen geringen oder höchstens mässigen Temperaturschwankungen unterworfen und nur in einzelnen Fällen erreichen die Fluktuationen ein erheblicheres Ausmass. Sodann ist von Bedeutung, ob eine Probe von den oberen Wasserschichten und der Spiegelfläche des Gewässers



geliefert oder ob sie vom Gewässergrund heraufgeholt ist. Unterschiede in den ökologischen Verhältnissen spiegeln sich jeweils prompt in der Zusammensetzung der Organismenbestände der betreffenden Biotope wieder. Die unseren Zwecken dienliche synoptische Darstellung sub b) lässt uns das Gesagte sehr evident erscheinen. Das Material von Prob. Nr. 24 entstammt einem Standort mit raschbewegtem, reichdurchlüftetem und kalkreichem Wasser. In diesem Falle beträgt der *Diatomeen*anteil über 90 % von der Gesamtvertretung. Die Darstellung, die sich auf Prob. Nr. 18 bezieht, lässt erkennen, dass die *Cyanophyceen* darin mit der doppelten Stärke einer normalen Vertretung figurieren, die Kieselalgen nur wenig überrepräsentiert sind und die *Desmidiaceen*quote wenig unterhalb des mitteleuropäischen Durchschnittes gelegen ist. Vom ökologischen Standpunkte aus beurteilt stehen die wahrgenommenen Verhältnisse in völligem Einklange mit den allgemeinen Erfahrungen, namentlich was die *Desmidiaceen*-komponente anbelangt. Der Standort von Prob. Nr. 18 ist gekennzeichnet durch Stagnation, Seichtheit, bedeutende Aufwärmungsmöglichkeit des Wassers, erhöhten (nicht hohem!) Humussäuregehalt und den Pflanzenreichtum, alles Momente, die dem *Desmidiaceen*gedeihen in hohem Grade förderlich sind. Bei den Positionen in der Rubrik der Prob. Nr. 26 fällt die übermässig hohe Besetzung der *Flagellaten*klasse auf. Auch in diesem Falle stehen die ökologischen Voraussetzungen in völligen Einklange mit den erhaltenen Resultaten. Der Ort der Ausbeute repräsentiert diesmal einen Graben mit eutrophem, schwachbewegtem und untiefem Wasser und reichlichen Mengen eines schwärzlichen, halbsapropelischen Schlammes, alles zusagende Existenzbedingungen für die Entfaltung eines reichen *Flagellaten*lebens.

Auch bei der Kommentierung des Tabelleninhaltes der Gruppenstatistik können nur die wesentlichsten Punkte herausgehoben werden. In bezug auf die *Diatomeen*frequenzliste fällt zunächst auf, dass die Genera: *Cymbella*, *Gomphonema* und *Nitzschia* in positivem Sinne abweichen. Ihre über dem Durchschnitte stehenden Vertretungen müssen einesteils der Wasserbewegung ( $\frac{2}{3}$  der Proben stammen aus fließendem Wasser), andernteils dem hohen Kalkgehalte des Mediums zugeschrieben werden. Aus den gleichen Gründen weist auch das Genus *Synedra* einen kleinen Ueberschuss auf. Im Gegensatz hiezu konstatieren wir bei den Genera: *Eunotia*, *Navicula* und *Pinnularia* eine zu schwache Vertretung. Von den *Eunotien* und *Pinnularien* ist bekannt, dass der grössre Teil ihrer Arten kalkarmes Wasser bevorzugt oder gar verlangt. Betreffs der Gattung *Navicula* muss in erster Linie das Argument „fließendes Wasser“ in Berücksichtigung gezogen werden. Bei der Konfrontierung der *Desmidiaceen*liste zeigt es sich, dass die *Cosmarien* stark überrepräsentiert sind. Dies ist zweifelsohne dem Umstande zuzuschreiben, dass dieses Genus eine nicht unbeträchtliche Zahl von Arten in sich schliesst, die

kalkhold oder doch kalkertragend sind. Das Genus *Closterium* hat normale Vertretung. Alle übrigen Genera sind zu schwach oder auch gar nicht vertreten. Ein höherer Kalkgehalt wird vor allem nicht vertragen von den Arten der Genera *Arthrodesmus*, *Tetmemorus* und *Xanthidium*; in abgeschwächtem Masse gilt dies auch für die Vertreter der Gattungen *Euastrum*, *Micrasterias*, *Staurastrum*, *Desmidium*, *Sphaerosoma* usw.

#### 4. Auswertung der Untersuchungs- und Analysenergebnisse

Die durch die Untersuchung bekannt gewordenen Tatsachen versetzen uns in die Lage, eine Reihe bedeutsamer Schlüsse über die Floristik, Biologie und Oekologie der Algen zu ziehen, deren Formulierungen wir nachstehend in zwangsloser Reihenfolge zur Kenntnis bringen. Dabei möchten wir vorausschicken, dass die einzelnen Schlussfolgerungen nicht zu absolut und unveränderlich aufzufassen sind. Es werden darin nur die wesentlichsten Punkte festgehalten, die in grossen Umrissen allgemeine Gültigkeit zu besitzen scheinen, im einzelnen aber je nach Zone, geologischem Charakter und erdgeschichtlichen Abläufen innert gewisser Grenzen variieren können.

1. Die Algenflora der Quellflur von Werriken muss in ihrer Gesamtheit als reichhaltig bezeichnet werden.

2. Zufolge des Vorherrschens fließender Gewässer alkalischer Reaktion weist die Algenflora des Untersuchungsgebietes einen durch die speziellen Umweltsbedingungen hervorgerufenen spezifischen Zug auf.

3. Dieser durch die Standortverhältnisse geschaffene Grundzug besteht darin, dass in der floristischen Komposition der Algen das *Diatomeenelement* uneingeschränkt dominiert und bestimmte fädige Grünalgen Massenproduktionen bilden.

4. Die Wasserbewegung wirkt sich zunächst in dem hohen Prozentsatz rheophiler und aërophiler Formen aus; sodann bedingt sie als Extremfaktor das häufigere Auftreten von Massenformen. Nach unserer Erfahrung scheint die Tatsache Gültigkeit zu haben, dass in den extremen Lagen massgebender Milieufaktoren einzelne Arten mit ihrer Individuenfülle herausstechen, indes sich das Gros der andern quantitativ stark unterordnet. Im Gegensatz dazu konstatiert man z.B. bei einer Reaktion um den Neutralpunkt herum eine grosse Zahl von Arten mit gehobener, jedoch nicht stark auffälliger, Individuenzahl und darum herum, ohne nennenswerte Abstufung, die zahlreiche Begleiterschaft.

5. Die im Gebiete zu verzeichnenden Massenformen rekrutieren sich vornehmlich aus den Lagern der *Diatomeen* und *Chlorophyceen*, die mehr als die übrigen Algenklassen auf die Besonderheiten der standörtlichen Verhältnisse zu reagieren pflegen. Daneben macht uns die Statistik mit keiner einzigen *Desmidiaceen*-Massenform bekannt, die sonst in den Hoch- und

Zwischenmoorbiozöosen eine häufig zu beobachtende Erscheinung bilden.

Für das Gebiet konnten folgende Massenformen festgestellt werden: *Oscillatoria Borneti*, *Chlorosaccus ulvaceus*, *Cyclotella Kuetzingiana*, *C. operculata*, *Fragilaria capucina*, *F. construens* var. *venter*, *F. leptostauron* var. *dubia*, *F. pinnata* u. var. *lanceolata*, *Synedra acus* var. *radians*, *S. amphicephala* u. var. *austriaca*, *S. rumpens*, *S. ulna*, *Cocconeis pediculus*, *C. placentula* u. var. *euglypta*, *Achnanthes minutissima* u. var. *cryptocephala*, *Diploneis puella*, *Navicula cryptocephala*, *Cymbella Cesati*, *C. helvetica*, *C. microcephala*, *C. tumidula*, *Gomphonema parvulum* var. *micropus*, *Chaetophora elegans*, *Microspora*-Arten, *Vaucheria clavata*, *Zygnemales*-Vertreter, *Batrachospermum moniliforme*, *Chara*.

6. Im Gebiete g e m e i n e Algen, d.h. solche, die in sämtlichen (32) oder doch sehr zahlreichen Proben nachgewiesen werden konnten:

a) In mindestens 30 Proben nachgewiesen: *Synedra ulna*, *Eunotia arcus*, *Achnanthes minutissima* var. *cryptocephala*, *Navicula cryptocephala*, *Navicula radiosa*.

b) In mindestens 2 Dutzend Proben nachgewiesene Algen: *Cyclotella Kuetzingiana*, *Cocconeis placentula* var. *euglypta*, *Achnanthes flexella*, *Diploneis ovalis*, *Gomphonema constrictum*, *Nitzschia linearis*.

Aus obiger Zusammenstellung ist ersichtlich, das sämtliche im Gebiet stark verbreiteten Algen Angehörige der *Diatomeensippe* darstellen. Von den 11 des Verbreitungsmaximums sich erfreuenden Vertretern konnte einzig *Navicula radiosa* in all den 32 Proben angetroffen werden.

6. Die Antipoden der Massenformen werden von den sog. *S o l i t ä r f o r m e n* vertreten, d. h. von solchen Organismen, die im ganzen Verbreitungsgebiet und zu jeder Zeit mehr vereinzelt aufzutreten pflegen. Für ganz seltene oder erst in jüngster Zeit bekannt gewordene Algen sind die diesbezüglichen Verhältnisse selbstverständlich noch zu wenig geklärt. Indes gestattet unsere langjährige Erfahrung bei den etwas verbreiteteren Formen die Eingliederung in diese Kategorie mit einer gewissen Sicherheit vorzunehmen. Die nachfolgende Zusammenstellung will indes keinen Anspruch auf Vollständigkeit erheben:

*Synechococcus aeruginosus*, *Euglena spirogyra*, *Achnanthes Clevei*, *A. flexella* var. *alpestris*, *Caloneis alpestris*, *C. bacillum*, *Neidium dubium*, *N. fasciatum*, *Frustulia vulgaris*, *Stauroneis Smithii*, *Anomoeoneis exilis*, *Navicula bacilliformis*, *N. dicephala*, *N. Reinhardtii*, *Pinnularia gracillima*, *Gomphonema longiceps* var. *montanum*, *G. subtile*, *Denticula tenuis* var. *crassula*, *Nitzschia angustata*, *Cosmarium cymatopleurum*, *C. Debaryi*, *C. Pokornyanum*, *C. turgidum*, *Staurastrum Bieneanum*, *Gonatozygon monotaenium*.



7. Die spezifische Algenflora des f l i e s s e n d e n Wassers: Das Hauptmerkmal der Lebensstätten der fließenden Gewässer ist die Strömung. Folgeerscheinungen: grössere Konstanz des Sauerstoffgehaltes und der Temperatur. In rasch oder sehr rasch bewegten Wasser ist die Artenzahl reduziert, in der Regel dagegen nicht die Individuenzahl. Die an das lebhaft bewegte Wasser angepassten Algen sind durch bestimmte morphologische und biologische Besonderheiten ausgezeichnet. Torrenticole Formen besitzen in der meisten Fällen eine geringe Grösse; Nadelform und Abplattung sind geeignet die entwicklungsfeindliche Wirkung der Strömung herabzumindern. Die im Wasser gefälls-starker Bäche lebenden *Closterien* sind gehörnte oder mit nadeligen Enden ausgestattete Formen, die sich im Pflanzen- und Fadengewirr festzuhaken vermögen. Der beste Schutz gegen das Fortgerissen- und Verschlagenwerden ist die Festheftung. Als Haftmittel dienen den Algen Klebscheiben, Gallertstiele und -schläuche, Rhizoiden und dergl. Bei den Rheophilalgen ist Kolonienbildung eher häufig. Dagegen könnte der Einwand erhoben werden, dass damit der mechanischen Wirkung der Strömung in die Hand gearbeitet werde, statt ihr entgegen. Andererseits ist in Berücksichtigung zu ziehen, dass die gebildeten Bänder (*Fragilarien*), Fäden (*Melosiren*), Ketten (*Diatoma* vulg.), einfachen und verzweigten Schläuche (*Encyonema*) infolge ihrer oft beträchtlichen Länge Algenfäden, Moosblätter und -stengel zu umschlingen vermögen, womit dann auch die Festkettung erfolgt. Hand in Hand mit dem Sessilwerden geht eine Reduktion des Bewegungsorgans (Raphe bei den *Diatomeen*) einher; die Raphe fehlt z.B. ganz bei den *Diatoma*-Arten, bei *Meridion*, *Fragilaria* und *Synedra*.

a) Rheobionte Vertreter: *Diatoma hiemale* var. *mesodon*, *Meridion circulare*, *Chlorosaccus ulvaceus*. Der bezeichnendste Vertreter dieser ökologischen Gruppe, *Ceratoneis*, scheint dem Gebiete zu fehlen.

b) Rheophile Vertreter: *Melosira arenaria* p. p., *M. varians* p. p., *Diatoma elongatum* u. var. *tenue*, *Diatoma vulgare* u. Varietäten, *Synedra ulna* p. p. (ist im allgemeinen eurytop), *S. amphicephala*, *Cocconeis pediculus*, u. *placentula* *Achnanthes Clevei*, *A. conspicua*, *A. exigua* u. var. *heterovalvata*, *A. lanceolata*, *Navicula gracilis*, *N. Reinhardtii*, *Cymbella aspera* (abgeschwächt), *C. naviculiformis*, *Gomphonema angustatum*, *G. olivaceum*, *G. parvulum* (abgeschwächt), *Microspora amoena*, *Closterium parvulum* p. p., *Cosmarium crenulatum* var. *tumidulum*, *C. vexatum* p. p., *Batrachospermum moniliforme* p. p.

8. Bryophile Formen des hydrotischen Typs:

*Synechococcus aeruginosus*, *Synedra capitata*, *Navicula hasiaca*, *Rhopalodien*, *Epithemien*, *Surirella spiralis*, *Pleurotaenien*, *Euastren*, *Micrasterien*, *Cosmarium connatum*, *C. cymatopleurum*, *C. Debaryi*, *C. depressum* und var. *achondrum*, *C. globosum*,

*C. margaritatum*, *C. pachydermum*, *C. reniforme*, *C. turgidum*.

Diese kleine Auswahl beweist, dass es sich bei dieser ökologischen Gruppe vor allem um Vertreter der Cyanophyceen, Diatomeen und Desmidiaceen handelt. Die meisten von ihnen sind auch aërophil.

## 9. Aufwuchsformen an Fadenalgen:

Die den Gewässergrund überziehenden oder in den oberflächlicheren Wasserschichten flutenden Fadenalgen sind mitunter sehr stark mit epiphytischen Kieselalgen besetzt, so namentlich zu Ende des Winters, wenn die Diatomeen ihr Entwicklungsmaximum aufweisen. Als Substrat konstatierten wir im Gebiete: Fäden von *Melosira varians*, *Zygnemen*, *Chaetophora elegans*, *Microspora*-Arten, *Cladophora fracta* var. *lacustris*, *Vaucheria clavata*, *Batrachospermum*. An entsprechenden Epiphyten sind folgende zur Beobachtung gelangt: *Meridion circulare*, *Synedra acus* var. *radians*, *S. amphicephala* und var. *austriaca*, *S. rumpeus*, kleinere Formen von *S. ulna*, *Cocconeis pediculus*, *Eunotia lunaris*, *Achnanthes minutissima* und var. *cryptocephala*, *Rhoicosphenia curvata*, *Gomphonema intricatum* var. *pumilum*. Als besonders eindrucksvoll erwiesen sich die strahligen Büschel von *Synedra amphicephala*. *Cladophora fracta* var. *lacustris* erfreute sich als Substrat der grössten Beliebtheit.

10. Die Zusammensetzung der Algenflora des Gewässergrundes des abziehenden Baches weist gegenüber derjenigen der spiegelnahen Wasserschichten bestimmte Unterschiede auf, die im folgenden kurz berührt werden sollen. In den Niveaus näher der Oberfläche fluten, an den im Wasser stehenden höheren Pflanzen befestigt, reichlich Algensträhnen, geliefert von *Zygnema*, *Microspora* und *Cladophora fracta* var. *lacustris*, die mitunter mit ganzen Pelzen epiphytischer Kieselalgen, vornehmlich *Synedren* und *Cocconeis*-Arten besetzt sind. Am Gewässergrunde siedeln, je nach Bodenbeschaffenheit, verschiedene makrophytische Algen. Im Schlammgrunde verwurzelt finden wir an einzelnen Stellen in reichlicher Ansammlung *Vaucheria clavata* und ab und zu auch *Charen*. An den wenigen Stellen, wo das Bachbett etwas steinig ist, begegnen wir Vegetationen gebildet von *Batrachospermum* und *Chaetophora elegans*. Auch diese sessilen Grossformen des Gewässergrundes tragen ihre epiphytischen Begleitorganismen, die ungefähr dieselben sind, wie in den Algensträhnen der Spiegelflächennähe. An den meisten Orten trägt der Bachgrund keine makrophytischen Algenbewüchse. Indessen ist der angehäuften und lockere Schlamm nicht etwa steril, sondern an der Oberfläche und in deren Nähe stark von lebenden oder sedimentierten toten Kleinalgen besetzt und durchsetzt. Neben den bekannten abgesunkenen Epiphyten der Algensträhnen begegnen wir gewissen benthischen *Navikeln*, *Diploneis*-

Arten und namentlich einer Unmenge von *Fragilaria*-Bändern. Die *Fragilarien* geben der Grunalgenflora das Gepräge, während im Epiphytenmaterial die *Synedren* die Physiognomie bestimmen.

11. Sämtliche Algen des Gebietes ertragen einen höheren Kalkgehalt des Wassers. Sie gehören daher zu den basiphilen Formen oder dann sind es euryözische Algen. Typische Weichwasserformen fehlen völlig.

12. Die *Desmidiaceen*vertreter im Werrikerbach. Gewässer mit höherem Karbonatgehalt sind stets desmidiaceen-arm. Dies gilt besonders für fließende Gewässer. Es dürfte daher von Interesse sein zu erfahren, welche Zieralgen etwa an der Zusammensetzung der Bachalgenflora unter den speziellen Bedingungen eines höheren Kalkgehaltes beteiligt sind. Die Liste für unser Bachgewässer lautet:

*Closterium acutum*, *Cl. malinvernianiforme*, *Cl. parvulum*, *Cosmarium bioculatum* forma, *C. Braunii* var. *Pseudoregnellii*, *C. crenatum*, *C. didymochondrum*, *C. difficile*, *C. granatum*, do. var. *subgranatum*, *C. holmiense* var. *integrum* f. *constricta*, *C. impressulum*, *C. laeve*, *C. ochthodes*, *C. Pokornyanum*, *C. punctulatum*, *C. subcrenatum*, *C. tetraophthalmum*, *C. vexatum*, *Staurastrum alternans*, *S. dispar*, *S. punctulatum*, *Gonatozyggon monotaenium*.

### 13. Bemerkenswerte und neue Formen.

Im Laufe der Untersuchung sind eine Anzahl höchst seltener und bis anhin noch wenig beobachteter Formen bekannt geworden. Ein Teil davon ist für die Schweiz neu und eine Art auch für die Wissenschaft. Bei der letzteren handelt es sich um *Chlorosaccus ulvaceus*, dessen Diagnose in den Berichten der Schweiz. Bot. Ges. Jahrg. 1946 von den Autoren Vischer und Messikommer veröffentlicht worden ist. Die Liste lautet:

*Cocconeis thumensis*, *Achnanthes Clevei*, *Navicula Grimmei*, *N. subbacillum*, *Cymbella microcephala* f. *robusta*, *C. norvegica*, *Gomphonema subtile*, *Chlorosaccus ulvaceus* und *Cosmarium didymochondrum*.

### 5. Systematische Erörterungen zu einigen kritischen und abgebildeten Formen

I. *Cocconeis thumensis* A. Mayer: Die von uns (Fig. 1) zur Darstellung gebrachte Form weicht in den Umrissen etwas vom Original bei MAYER (*Bacillariales* v. Reichenhall, T. VI, Fig. 24) ab; statt rhombisch-elliptisch ist sie mehr breit-oval bis sub-sphärisch. Geringer ist der Unterschied gegenüber der HUSTEDT-schen Abb. in Dr. A. SCHMIDTS Diatom. — Atlas T. 407, Fig. 8 u. 10. Zu *Cocc. disculus* Schum. und *C. diminuta* Pant. kann sie trotz grösserer gestaltlicher Uebereinstimmung nicht gezogen werden, weil diese Vertreter statt Punkstreifen eine aus



Punktstrichen bestehende Ornamentierung aufweisen und erstere überdies nicht unerheblich grösser ist. Dimensionen unserer Form: Lge. 12,7  $\mu$ , Br. 10  $\mu$ , u. 15—16 Streifen pro 10  $\mu$ .

II. *Navicula subbacillum* Hust.: diese rezent bekannt gewordene *Diatomee* (HUST. Unters. üb. d. Diat. fl. v. Java, Arch. f. Hydrobiol. Suppl.-Bd. XV, S. 256, T. XVIII, Fig. 3—6) gleicht habituell stark der *Nav. bacillum* und der *Nav. bacilliformis*. Sie ist aber von geringerer Grösse, hat nicht wie erstere eine durch fetteren Streifen abgegrenzte strukturlose polare Area und besitzt eine wesentlich feinere Streifung als die letztere. Seit ihrer Entdeckung im Jahre 1928 in Material aus Sumatra ist sie 1941 auch für Europa (MANGUIN, Lit. 1) nachgewiesen worden. In unserem Gebiete ist sie, wenn auch stets vereinzelt vorkommend, keine Seltenheit. Ihrer Kleinheit wegen wird sie aber leicht übersehen. Dimensionen: Lge. 14—19  $\mu$ , Br. 4—4,5  $\mu$ , eine Anzahl Streifen beidseitig des Mittelknotens deutlicher und distanter, sonst sind sie aber äusserst zart und dicht gestellt (30—35 auf 10  $\mu$ ). — Tab. nostr. fig. 4.

III. *Cymbella microcephala* Grun. f. *robusta* Hust. (HUST.: Diatomeen aus d. Pyrenäen, Ber. Deutsch. Bot. Ges. Bd. LVII, Fig. 14, 15).

Ihre Frusteln sind fast völlig symmetrisch und sie gleicht habituell weitgehend einer *Navicula*, z.B. *N. incompta* Krasske (KRASSKE: Alp. Diat.). Auf Grund der Raphenverhältnisse und der allerdings sehr schwachen Asymmetrie zwischen linker und rechter Schalenhälfte müssen wir sie aber als *Cymbella* ansprechen. Diagnose: Schalen linear-lanzettlich, Ränder sehr leicht gewellt, Köpfchen ganz wenig einseitig abgeneigt, Raphe leicht geschweift, Querstreifen ganz schwach strahlend, zart punktiert, Streifen zu beiden Seiten des Mittelknotens entweder unverkürzt, aber mit zwei etwas grösseren Zwischenräumen, oder öfters zwei Streifen der einen Seite verkürzt, bisweilen nur noch am Rande erhalten. Unsere Alge gleicht der *Cymbella sphaerophora* nov. spec. bei Astr. CLEVE-EULER: The Diatoms of Finish Lapland, p. 78, T. V, Fig. 129, mehr jedoch noch der *Cymb. microc.* f. *robusta* Husteds, mit der wir sie mit gewissen Vorbehalten identifizieren. Dimensionen: 25,5—28,5  $\mu$  lg., 5,5—6,5  $\mu$  br., Streifen etwa 18 pro 10  $\mu$ . — Tab. nostr. fig. 7.

IV. *Cymbella austriaca* Grun. — Habituell weist unsere Form gegenüber der Abb. bei HUSTEDT (Bacillariophyta, 1930) bedeutende Unterschiede auf, indem namentlich die Ventralseite stärker und winklicher vorspringt, ausserdem ist die Axilarea verhältnismässig breiter. Die übrige Morphologie steht nicht im Widerspruch. Namentlich die Raphenausbildung nötigt uns den Anschluss bei *C. austriaca* zu suchen. Die habituell ähnlicheren *C.*

*laevis*, *leptoceros* u. *Reinhardtii* bleiben wegen ihrer geringeren Grösse, abweichendem Raphenbau und unpassenden Streifenverhältnissen ausgeschlossen. Unsere Messungen: Lge. 60—80  $\mu$ , Br. 18—20  $\mu$ , Streifenzahl Mitte Rückenseite 9, Mitte Bauchseite 10 pro 10  $\mu$ . — Tab. nostr. fig. 8.

V. *Chlorosaccus ulvaceus* Messik. et Vischer. — Es ist verwunderlich, dass diese ansehnliche Alge, bildet sie doch über 10 cm Länge messende Kolonien, nicht früher aufgefunden worden ist. \*) Allem Anscheine nach muss es sich bei ihr um eine exquisite Rarietät handeln. An der Fundstelle bildete die höher im Wasser flutende gelblichgrüne Heterokonte einen wirksamen Kontrast zu den dunkelgrünen Rasen von *Vaucheria clavata* des Bachgrundes. Eine einlässliche Beschreibung des Novums findet man in den Ber. Schweiz. Bot. Ges. 1946 (Lit. 8). Um Wiederholungen zu vermeiden verzichten wir an dieser Stelle auf eine Schilderung der Alge. Die Abbildungen und die Figurenerklärungen am Schlusse dieser Arbeit mögen genügen. — Lge. der Kolonien bis 12 cm, Einzelzellen durchschnittlich 6,5  $\mu$  lg. und 5  $\mu$  br. — Tab. nostr. fig. 10.

VI. *Pediastrum Pearsoni* G. S. West var. *orientale* Skuja. — Unsere Alge ist völlig identisch mit der SKUJA'schen Kreation. Sie hat keine näheren Beziehungen zu *Ped. Boryanum*, dagegen zu *P. integrum*, das trotz der gegenteiligen Ansicht gewisser Algologen als selbständige Art aufrecht erhalten werden muss. Von *P. integrum* unterscheidet sich die Varietät *orientale* von *P. Pearsoni*, und übrigens auch der Typus, vorallem durch die schräg gestellten Fortsätze. Die vollständigere Diagnose lautet: Coenobien geschlossen, seltener mit einzelnen Lücken, im Umriss entweder rundlich oder dann unregelmässig elliptisch, schliesslich auch fünf- oder sechseckig (unsere Abbildung!), einschichtig, seltener stellenweise zweischichtig, aus 4, 7, 8, 16, 28 oder 32  $\pm$  konzentrisch angeordneten Zellen bestehend, mit einem Durchmesser von 21—81  $\mu$ . Die zentraler gelegenen Zellen sind  $\pm$  sechseckig, die randlichen subhexagonae mit eckiggerundetem Aussenrand. Zelldurchmesser 10—16  $\mu$ . Länge der schiefangeordneten Fortsätze am Kolonierand etwa 5,5  $\mu$ . Pyrenoide einzeln. Zellmembran ziemlich dick, warzig skrobikuliert und farblos.

Hierher gehört auch *Ped. Boryanum* (Turp.) Menegh. apud MANGUIN, E.: Les Algues des Rochers suintants de Saint-Léonard-des-Bois, in Bull. d. l. Soc. d'Agriculture, Sciences et Arts de la Sarthe, année 1937, pag. 21, Pl. I, Fig. 3.

Unsere Alge kommt in Quellbächen, Gebirgsbächen und auf überrieselten Felsen vor and zwar in einer sehr charakteristischen Mikrobiozönose, die sich sowohl in unserer Quellflur im Glattale

\*) Die Alge wurde inzwischen und zwar am 6. Juni 1948 in einem Grundwasserkanal unterhalb Basel erneut nachgewiesen.

als auch im Gebirgsbache in Kleinasien wie folgt zusammensetzt: *Melosira arenaria*, *Cosmarium vexatum*, *C. subcrenatum*, *C. didymochondrum*, *C. holmiense* var. *integrum* f. *constricta*, *Chlorogloea microcystoides*, *Scenedesmen*, *Diatomeen* usw. — Tab. nostr. fig. 11.

VII. *Cosmarium globosum* Bulnh. — Es kostete uns Mühe, diese Alge systematisch am richtigen Orte einzureihen. Neben *C. globosum* kommt für den Anschluss noch sehr *C. pseudarctoum* Nordst. in Frage. Nach allem Abwägen haben wir uns zugunsten von *C. globosum* entschieden. Gegenüber dem Typus zeichnet sich unsere Form durch geringere Grösse aus. Lge. 26,6—27  $\mu$ , Br. 16,6—17  $\mu$ , Isthm. 13—13,3  $\mu$ .

Wir fanden einzelne abgestorbene Zellen dieser Alge, die mit einem pilzlichen Lebewesen infiziert waren. Bei dem Parasiten handelt es sich um einen Algenpilz aus der Gattung *Olpidium*. Es sind uns nur entleerte Sporangien des Pilzes zu Gesicht gekommen. Sie entwickeln sich offenbar in der Einzahl im Innern der Wirtszelle und durchbrechen diese zur Reifezeit mit einem langen vor dem Austritte kropfig angeschwollenem Entleerungsschlauch. Von den bekannten Vertretern der genannten Gattung steht *Olp. endogenum* A. Br., das auch in *Desmidiaceen*-Zellen schmarotzt, unserem Pilze am nächsten; doch sind seine Sporangien niedergedrückt-kugelig statt brotlaibförmig und verlängert wie in unserem Beispiele. Wir nennen unseren Parasiten, der offenbar eine neue Art darstellt: *Olpidium Cosmarii* sp. nov. — Tab. nostr. fig. 14—15.

VIII. *Cosmarium didymochondrum* Nordst. — Unser *Cosmarium* weicht in den Umrissen nicht unerheblich von der Originalabbildung bei NORDSTEDT ab. In der NORDSTEDT'schen Darstellung sind die basalen Ecken der Halbzellen mehr rechtwinklig, die beiden unteren Hälften der Seitenränder angenähert parallel zueinander, die Zellen im Verhältnis zur Länge schmaler, dagegen passt die Membransculptur, die wegen der Zartheit nicht so leicht festzustellen ist, gut zu unseren Verhältnissen. Vollständige Übereinstimmung mit unsern Funden konstatieren wir dagegen bei SKUJA, H. Vorarbeiten zu einer Alg. fl. von Lettland, IV, Taf. III, Fig. 20—22, und desgleichen in der Arbeit: Süßwasseralgen aus Griechenland und Kleinasien, Taf. III, Fig. 14. Die von uns erhaltenen Messungsergebnisse der Zellgrößen variieren wie folgt: Lge. 41,7—48,9  $\mu$ , Br. 33,4—39,1  $\mu$ , Isthm. 13,3—13,4  $\mu$ . — Tab. nostr. fig. 16.

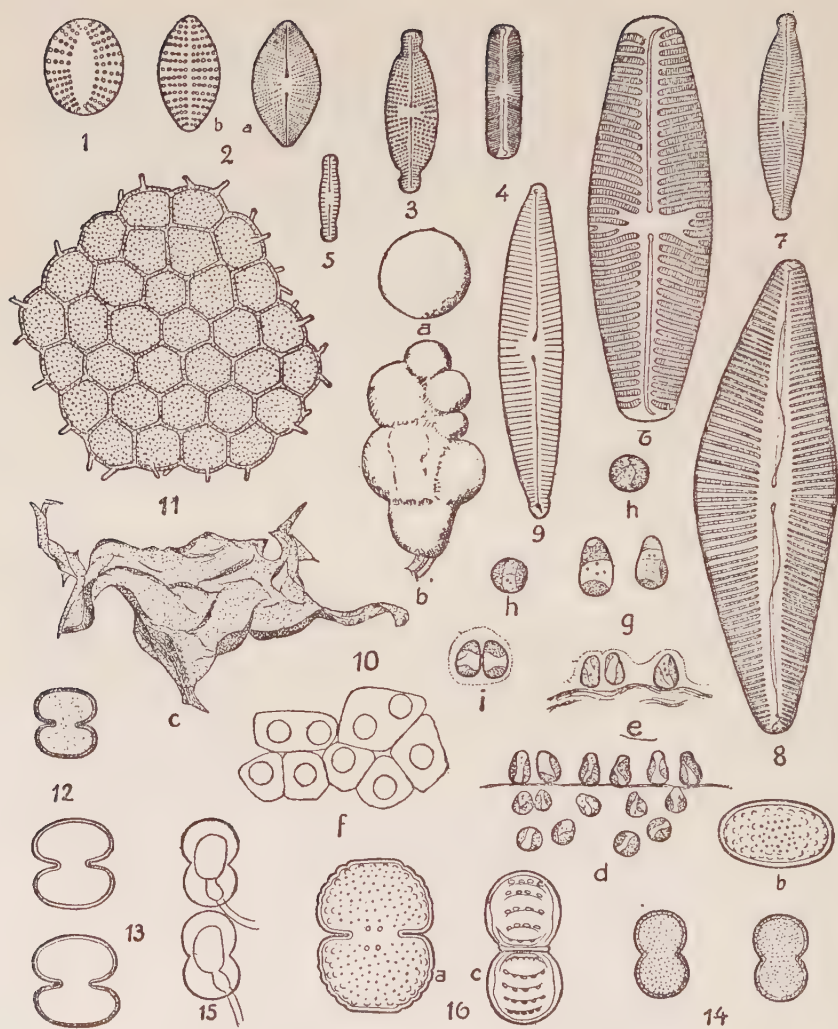


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## ERLÄUTERUNGEN ZUR TAFEL

- Fig. 1. *Cocconeis thumensis* A. Mayer, Ansicht der raphenlosen Schale.  
 „ 2. *Achnanthes Clevei* Grun. a) raphentragende Schale, b) raphenlose Schale.  
 „ 3. *Navicula Grimmei* Krasske.  
 „ 4. — *subbacillum* Hust.  
 „ 5. — *hassiaci* Krasske.  
 „ 6. — *Reinhardtii* Grun.  
 „ 7. *Cymbella microcephala* Grun. f. *robusta* Hust.  
 „ 8. — *austriaca* Grun. forma.  
 „ 9. — *norvegica* Grun.  
 „ 10. *Clorosaccus ulvaceus* Messik. et Vischer.  
 a) Junge blasige Kolonie, b) id. mit gerundeten Auswüchsen, c) älteres, aufgerissenes Stadium, d) kleiner Ausschnitt vom Kolonierand, ohne Färbung, e) id. bei Färbung mit Methylenblau (die aufgelagerte zartere Gallerte, in der die Zellen eingebettet sind, ist nun sichtbar), f) Ansicht der Zellen und Gallertkuppen von oben (nach einem gefärbten Präparat), g) einzelne Zellen in Seitenansicht, h) Zellen von oben gesehen, i) zwei Tochterzellen in der Seitenansicht.  
 „ 11. *Pediastrum Pearsoni* G. S. West var. *orientale* Skuja.  
 „ 12. *Cosmarium bioculatum* Bréb.  
 „ 13. — *contractum* Kirchn. var. *ellipsoideum* (Elfv.) W. u. G. S. West.  
 „ 14. — *globosum* Bulnh.  
 „ 15. do. mit Parasit (*Olpidium Cosmarii* sp. nov.).  
 „ 16. — *didymochondrum* Nordst.



# Luminosity Measurements in Aswan Reservoir, Egypt.

by

G. ABDIN, Ph. D., F.L.S.

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## I. INTRODUCTION AND METHOD

It appears desirable at the outset to classify the different methods adopted by the various investigators for the measurement of luminosity in water as follows:—

- a) Limit of visibility methods.
- b) Photographic methods.
- c) Photochemical methods.
- d) Pyrolimnometer methods.
- e) Spectrophotometric methods.
- f) Photoelectric cell method.

The last method was adopted by Pearsall and Ulliyott (*Journal of Experimental Biology* Vol. 10). In their method two photoelectric cells were necessary. One cell is lowered into the water in a water tight container while the other remained in an equivalent container on the deck of the boat from which observations were made. A thermionic potentiometer was also connected in the circuit in conjunction with a unipivot galvanometer. Among the disadvantages of this system is the bulk of the amplifier and its screen.

In the present investigation measurements of light were made with a Weston photronic cell placed in water tight case possessing a glass window.

The principal involved is that we shunt the ammeter with a resistance  $R_2$ . Then keeping  $R_2$  constant, the current passing through the ammeter varies as the E.M.F. of the photo cell. Since the E.M.F. of the photo cell varies directly according to the luminosity, the ammeter reading also varies according to the luminosity. Circuit diagram of apparatus is shown in fig. (1).

The apparatus was calibrated by means of a standard photometer and to each shunt reading a factor was determined. If we multiply this factor by the microammeter reading we get the luminosity in absolute units, i.e. footcandle. No filters were used. Consequently measurements were made of only total visible light. Current generated by the photronic cell was measured by a unipivot microammeter furnished by the Cambridge Scientific



Instrument Company No. L 51477 with a full scale deflection of 24 units. Light readings were made in the air just above the surface. Then the photo cell was lowered by means of a hand winch. Readings were made at intervals of 20 cm. wherever possible. Duplicate readings for a given depth were made (on descending and ascending). Readings were made only when the sun was clear from clouds. Indeed, this was a great handicap because many a time we had to stop observations due to clouds covering the sky. Observations on the conditions of water, weather, wind and sky were taken every day luminosity measurements were taken.

Fig. (2) represents the apparatus in working order:—

g — is a loop of the apparatus which is suspended from the winch by the wire W.

I — is a weight which slides over the arm (A) to keep the apparatus level.

E — is an attachment for a sounding weight T.

X — is a metal hemisphere containing the photoelectric cell with terminals connected by wire (H) to the microammeter. This metallic hemisphere has a brass strip which fits closely over it when not in use.

In suspending this apparatus into the water, every care was taken to ensure that the photo-cell was away from the shading effect of the boat used during the investigations. It should also be realised that such factors as composition of light, angle of light falling upon the surface of water, surface loss, scattering and selective effect of suspended material, are not taken into consideration.

## II. LIGHT INTENSITY AT SURFACE

The intensity of illumination at the surface of water varies with a number of circumstances such as degree of cloudiness of sky, presence of smoke, dust or other occasional features of atmospheric conditions such as time of day and season of the year.

In the present investigation luminosity measurements were always made during the same period of the day (from 11 a.m. to 1 p.m.).

It is to be expected therefore that light measurement just above the surface of water would represent seasonal variation of light intensity through the different years. More than fifty series of readings were taken between December 1941 and July 1944; it is not proposed to tabulate them in detail because most of them repeat certain constant features of the typical series, but results are plotted as a graph in fig. (3).

In the following table certain series have been chosen for a

number of dates during the period of investigation. The dates were chosen because the results obtained on them were typical of the month which they represent and thus they show some fundamental points in the yearly cycle of light conditions. Data obtained on two successive dates are also represented in the table to show that the daily variation is practically absent.

Date	Time	Sunlight in foot candles	Date	Time	Sunlight in foot candles
21.12.41	12.15 p.m.	2943	21. 2.43	11.00 a.m.	4178
22.12.41	10.30 a.m.	2927	21. 3.43	10.30 a.m.	4310
12. 2.42	12.15 p.m.	2963	17. 4.43	11.00 a.m.	5466
13. 2.42	12 (noon)	3460	17. 5.43	11.00 a.m.	4762
14. 3.42	12. 5 p.m.	4964	17. 6.43	11.00 a.m.	3658
15. 3.42	10.30 a.m.	4572	19. 7.43	11.00 a.m.	4629
5. 5.42	11.15 a.m.	4748	5. 2.44	10.00 a.m.	2410
6. 5.42	11.45 a.m.	5842	15. 3.44	10.00 a.m.	3229
11. 6.42	12.30 p.m.	6003	15. 4.44	10.00 a.m.	3426
12. 6.42	12.15 p.m.	6568	16. 5.44	10.00 a.m.	5320
8. 7.42	11.40 a.m.	5704	15. 6.44	11.00 a.m.	4880
11. 7.42	11.00 a.m.	5850	7. 7.44	11.00 a.m.	3838
23.12.42	11.30 a.m.	3072			
21. 1.43	11.30 a.m.	4165			

The difficulty of reducing the results obtained throughout the year to some comparable working basis is very great, for not only there are absolute differences in the intensity and composition of the light, but also the average angular elevation from which it comes is much less in winter than in summer. In order to make the results as nearly comparable as possible the original readings should be corrected by multiplying by a factor which gives values corresponding to the angular elevation of light. This angular elevation of light is a subject of controversy and until the matter is settled, it is quite fair to consider the results as representative of intensity at the surface.

It is apparent then, that the distribution of light through the year varies through the different seasons. The lowest surface intensity was in December and January, the highest in May and June.

### III. TURBIDITY IN THE RESERVOIR WATERS.

Transmission of light through natural waters usually shows an inverse relationship to the degree of turbidity (Chandler 1942). Turbidity is a condition resulting from the presence of suspended matter. Although all natural waters contain suspended materials, they vary widely in their specific amount of turbidity.

From a biological point of view little seems to be known concerning the specific effect of turbidity upon the physiological process of organisms. So, it is difficult to determine whether the

effects of high turbidity are in the nature of obstruction of any particular physiological process or mainly an indirect mechanical effect. Thus certain plankton occurs and thrives well in maximum turbidity all the year round (e.g. *Melosira varians*) while some survives the enforced exposure to temporarily high turbidity in time of flood and at low water stage but cannot permanently endure these conditions (e.g. *Melosira granulata*).

Studies designed to determine the depth at which maximum rate of photosynthesis occurs for the more important phytoplankton under various degrees of turbidity have not attracted the attention of investigators, although there is a wide field of enquiry here.

Turbidity in Aswan Reservoir may be considered to be due to:—

a) Silt in water. When in flood the Atbara and Blue Nile (two main tributaries of the R. Nile) annually bring down in suspension large quantities of silt from the Abyssinian Plateau. The earliest known scientific Study of this was made by the engineers who accompanied Napoleon to Egypt. They estimated from the depth to which antiquities were buried that the average rate of silt deposit amounted to about 10 centimeters per century. More recent estimates (BALL 1939) have confirmed this figure and today it is generally accepted that the mean rate of deposition is about 9 cms. per century.

The presence of silt in Nile water however, besides entailing every year a heavy expenditure for its removal from canals, has also the disadvantage of limiting the time of storage in the reservoir.

The rule in the past to avoid any risk of silting up the Aswan reservoir, was to start filling after the peak of the flood had passed and the gauge downstream had fallen to such an extent that the quantity of silt in the water would have decreased considerably. But with the increase of the capacity of the reservoir due to two heightenings of Aswan Dam, filling now usually starts about the middle of October when the Aswan gauge falls to 91.00 meters above sea level. The date will have to be still further advanced if the storage level is raised to 122.00 meters to meet the programme of the near future development.

The reservoir is empty in flood and during a high flood the Aswan Reservoir might be used as an emergency flood escape; that is keeping the downstream gauge at a certain level and holding up the extra flow in the reservoir. Thus each of the two functions of the reservoir, namely conservation and flood control involves the retention in the reservoir of some of the silt laden flood water. Hence the important question arises: How much silt would be deposited by storing flood water in the reservoir? This question is of vital interest to Egypt for if it should prove that water could safely be impounded in flood with-



in the Nile, considerably less than 100 p.p.m. by weight. Towards out any serious diminution of reservoir capacity, the whole scheme of future projects would have to be revised.

Careful determinations of quantity of silt in suspension in the Nile were carried out by the Physical Department in 1929, 1930, 1932, 1935 and 1939. The result showed that, from January to nearly the end of July there is very little suspended solid material the end of July and the beginning of August the concentration increases rapidly to a maximum which is usually reached late in August. In a high flood it may reach 4000 p.p.m. by weight for a few days. The concentration then falls off gradually until in December it again becomes less than 100 p.p.m.

The author has carried out mechanical analyses to determine the quality of silt. The general conclusion is that the percentage of silt and clay diminish whereas those of sand increase with the progress of flood. The average proportion for the whole suspended matter carried by the flood are roughly:—

Coarse Sand	none or trace
Fine Sand	30 %
Silt	40 %
Clay	30 %

No definite relation of the variation of silt content with the depth has been discovered.

b) Non settling suspended matter.

By non settling suspended matter is meant either those exceedingly finely divided solids or those materials whose specific gravity is less than water and which are in permanent suspension as long as their state remains unchanged. In a general way these non settling materials may be divided into two classes:—

- i) Plankton organisms and coarsely divided non-living substances whose specific gravity is such that they are constantly suspended.
- ii) Very finely divided non-living materials and organisms of exceedingly small size.

#### IV. LIGHT TRANSMISSION CURVES

The percentage of light absorbed per meter of water for each series of readings is shown in the following table. The percentages included are calculated from absolute readings of luminosity at the various depths.

Percentage Absorption per meter										
	0—1	1—2	2—3	3—4	4—5	5—6	6—7	7—8	8—9	9—10
22.12.41	97	96								light ripples
12. 2.42	88	84	87	81						no ripples
14. 3.42	79	71	76	67	78	67				water ripples
6. 5.42	49	55	44	39	28	48	32	44	43	no ripples
11. 6.42	64	69	53	58	59	59	55	61	40	33
8. 7.42	99	98								light ripples
										water ripples
23.12.42	94	95								no ripples
21. 1.43	89	90	88							no ripples
21. 2.43	81	72	79	75	72					water ripples
21. 3.43	77	67	65	66	69	73				water ripples
17. 7.43	81	25	50	52	57	51	56	55		water ripples
17. 5.43	44	29	38	27	35	24	26	41	40	light ripples
17. 6.43	48	60	40	54	58	51	66	83		no ripples
19. 7.43	99									no ripples
5. 2.44	64	66	68	66	63	75				water ripples
15. 3.44	91	64	54	57	52	56				water ripples
15. 4.44	77	48	49	59	56	63				light ripples
16. 5.44	86	26	29	45	44	48	83			no ripples
15. 6.44	86	63	60	63	64	64	34	29	27	water ripples
6. 7.44	99									no ripples

These coefficients of absorption for each meter of water within each series of light readings indicate that water was seldom optically homogeneous. This condition is not surprising when it is realised that strong winds are completely lacking. Optically homogeneous conditions usually prevail in turbid waters when severely agitated, while heterogenous conditons characterize calm and undisturbed waters.

The foregoing table shows that surface water agitation contributes to this heterogeneity. The percentage of light absorbed per meter of water was not uniform from top to bottom, but in general there was a greater degree of uniformity within those series made when there were water ripples. Further, the percentage of light absorbed per meter within a series was more variable for readings made from February to June than for any other time of the year. This is explained by the fact that during the months November, December and January a gradual clearing of the reservoir water is to be expected, but no especially marked change in the rate of settling occurred. Starting from February however the settling of this suspended material did not proceed at uniform rates at all depths. Unfortunately however there is no available data as regards the rate of settling of this suspended matter during the damming period of the river.

Light transmission curves were usually straight lines (fig. 4). Some of the curves (fig. 5) particularly those of May und June were quite irregular. The fact that the blue-green Algae collect

in the most superficial layers of the water (PEARSALL 1933) may account for the considerable variability of light penetration in these two months. The irregular portion of the curves usually lies within the first meter. The following table shows the percentage of surface light occurring at the depth of one metre.

Date	% at one metre depth	Date	% at one metre depth
22.12.41	2.8	17. 4.43	18.3
13. 2.42	10.8	17. 5.43	54.7
14. 3.42	18.4	17. 6.43	54.0
6. 5.42	51.0	19. 7.43	0.1
11. 6.42	31.5	5. 2.44	35.3
8. 7.42	0.7	15. 3.44	8.4
13.12.42	5.5	15. 4.44	22.5
21. 1.43	10.2	16. 5.44	13.2
21. 2.43	18.5	15. 6.44	20.6
21. 3.43	22.3	6. 7.44	0.4

Inspection of these data shows that the gradual increase of percentage of surface light reaching 1 meter depth agrees well with the gradual clearing of the reservoir water as the season proceeds. In July, however the reservoir is changed into a muddy river and thus the greater proportion of surface light is cut in its way through the first meter.

The results obtained in 1944 are remarkable, light reaching 1 meter is greater in February through March and April than in May and June. This discrepancy can be easily explained if we consider that operations of the Dam necessitated the replacement of drawn water (for a greater area of rice cultivation in lower Egypt than the two previous years) by relatively muddy water from Gebel Aulia Dam. The latter dam is constructed at Gebel Aulia, 44 kilometres south of Khartoum. The reservoir is rather wide and shallow and so losses by evaporation and percolation into the ground are greater than in Aswan. It is for this reason that, as soon as it is necessary to use stored water and to draw on Aswan, the water drawn out is replaced from Gebel Aulia.

## V. EFFECTIVE LIGHT PENETRATION

Although it is assumed that the normal existence of healthy chlorophyll bearing plants at various depth levels in water may be taken as evidence that some of the effective light is present in sufficient intensity to enable these plants to perform photo-



synthesis, it must not be taken for granted that the lowest limit of green plants is the lowest limit of effective light penetration, since it is claimed by WELCH (1935) that certain Algal cultures have continued to grow in total darkness for long periods of time when the proper nutrient materials were supplied. Hence it may be that some Algae exist at great depths and without performing photosynthesis. If so, their presence would indicate nothing as to the depth to which light rays effective for photosynthesis would penetrate.

Nevertheless, since photosynthesis depend upon an adequate supply of the essential part of sunlight, the general statement may be made, that changes in transparency may alter the depth of the photic zone and thus affect the activity of the micro-organisms.

For the purpose of the present investigation the depth in meters at which intensity of light was cut down to one hundredth of that incident on the surface was considered as the range of the photic zone and was calculated on the basis in which the following assumptions are implicit:—

1. That such factors as composition of light, angle of the light falling upon the surface of water, surface loss, scattering, and selective effect of suspended material, are not taken in account in determining the depth to which 1 % of surface light penetrates.
2. That the vertical depth is a sufficient measure of the effective path of the downward penetrating light.

The depth to which 1 % of surface light penetrated into water at different times during the period of investigation is shown in figure (6). This curve shows that the depth at which surface light is reduced to 1 % varied from 0.5 to 11.10 m. depending upon the degree of turbidity.

These depths follow exactly the stage of the river for the greater part of the year (during diatom and colonial green maxima).

The curve during the early part of the year (December and January) coincides with an increased flow of water laden with a large amount of silt.

In February, March, April and May a gradual clearing of the reservoir water takes place. This is because the basin is rocky and the current is negligible during those months.

In June the depth to which 1 % of surface light penetrates is somewhat lessened. This is easily explained if we recall the fact that Aswan reservoir water is greatly diminished during this month.

In July the water is muddy and light penetration is greatly reduced. From July onwards flood water arrives and the turbidity is highest; the river is allowed to flow freely down stream and the water is too rough for light readings to be made.

## ACKNOWLEDGEMENT

The author who is now in England would like to express his indebtedness to Prof. W. H. PEARSALL, Quain Professor of Botany and director of laboratories, Botanical Dept., University College, London and to Dr. F. W. JANE, Reader in the same Department for the wealth of information and facilities they put at his disposal.

Grateful acknowledgement is also extended to Dr H. E. HURST, Director General of the Physical Dept. of the Ministry of Public works, Egypt, and his technical assistant N. BOULOS for valuable help.

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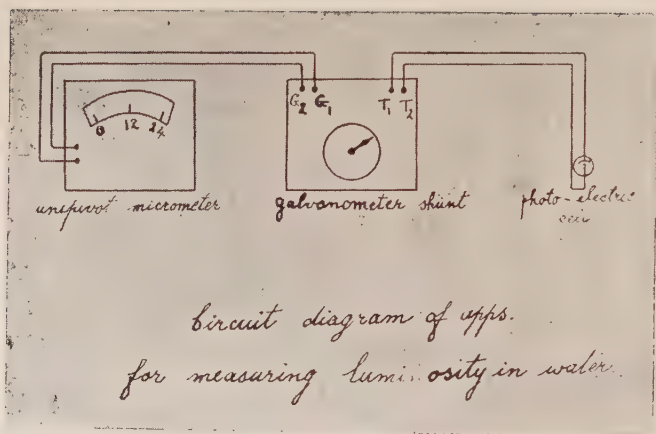


Fig. 1

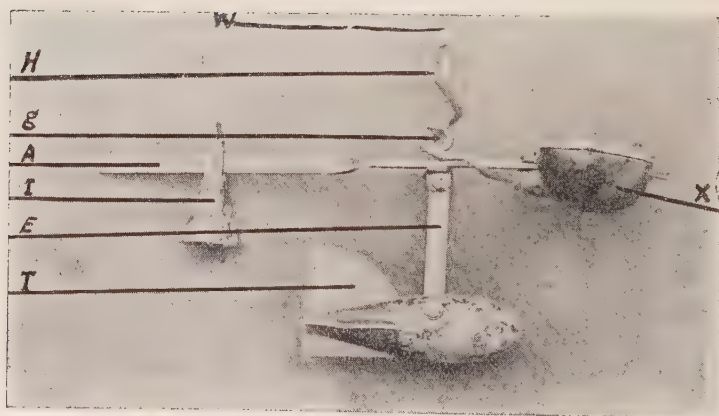


Fig 2



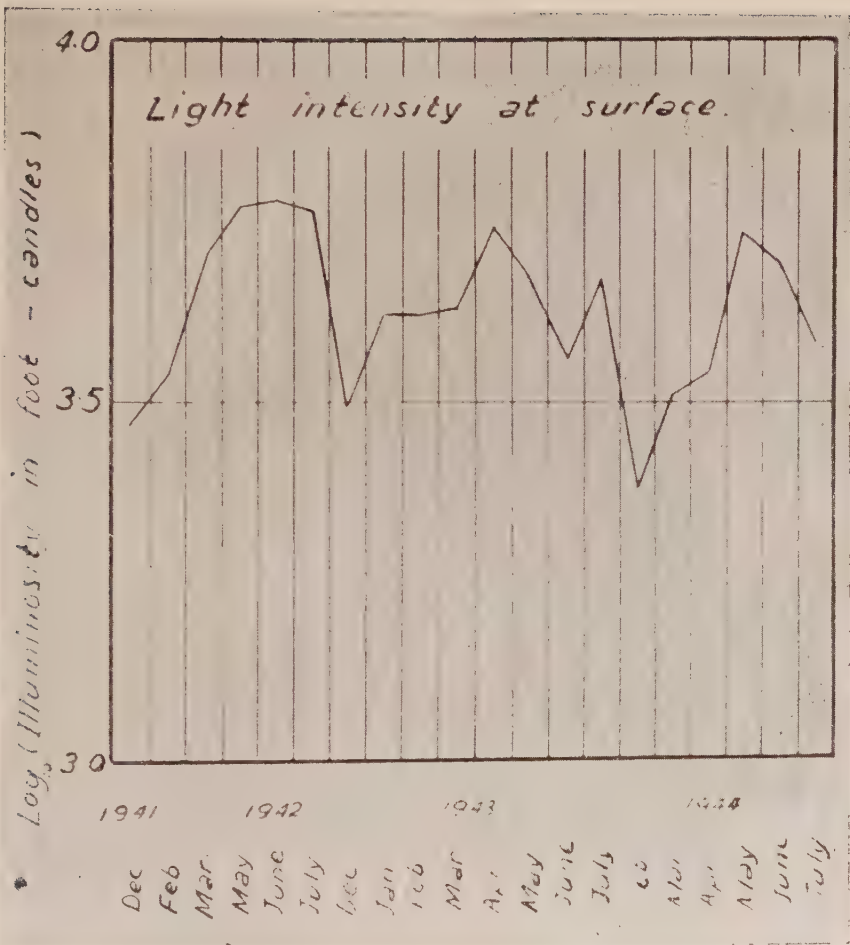


Fig. 3

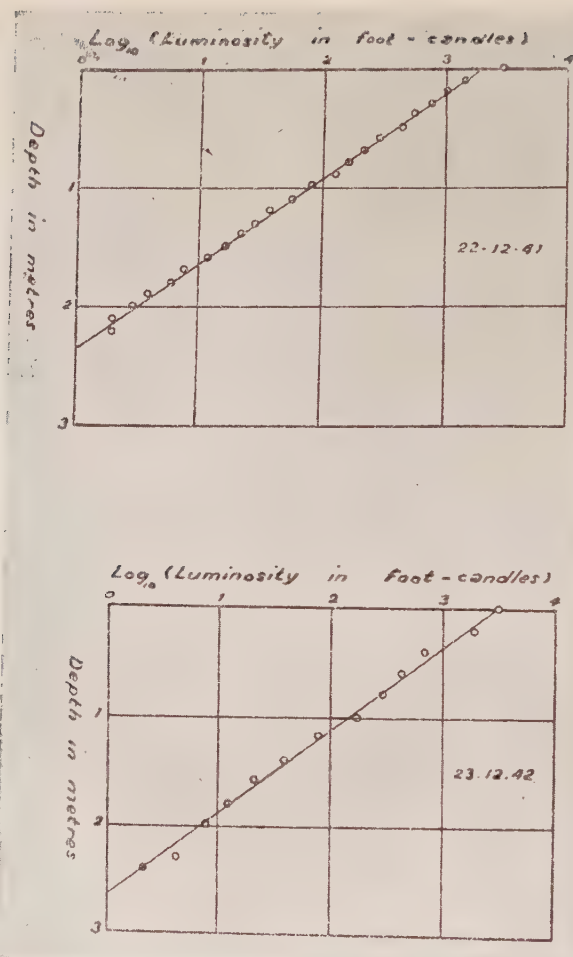


Fig. 4

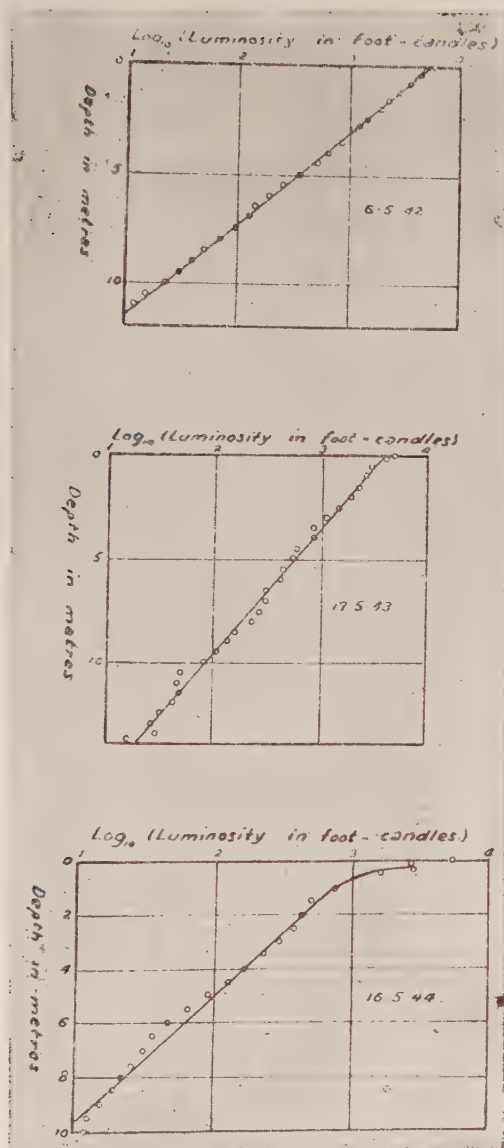


Fig. 5



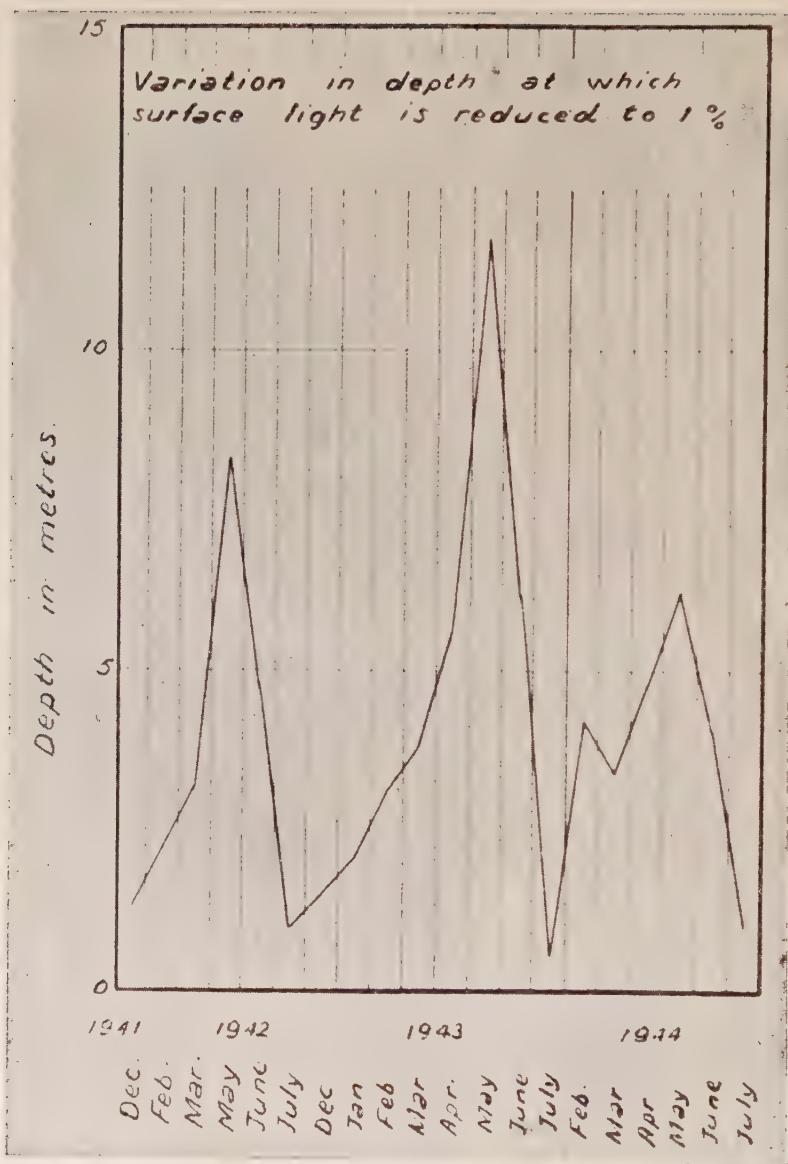


Fig. 6

# Contributions to the knowledge of Tendipedidae of Padova and Venice

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## INTRODUCTION

Although many authorities <sup>1)</sup> have progressed in the study of the Tendipedidae belonging to the north and central European fauna for many years, in this country there are no faunistic works, except some very old contributions of the great Italian dipterologist, BEZZI, and of some minor students. For the area in which I carried out my studies particularly, there is but the ancient work of CONTARINI (Catalogo degli Uccelli e Insetti delle provincie di Padova e Venezia, Bassano, 1843), which has only a historical value. The faunistic works of some more recent Italian Authors have a very doubtful value, since there are no determinations made by specialists, and even when this is the case, there are many doubts about the value of such determinations, made without the use of the true taxonomic characters, as known today.

As far as the provinces of Padova and Venice are concerned, no one had ever investigated from the point of view of the chironomidological fauna, neither for faunistics nor for ecology, since the days of CONTARINI <sup>2)</sup>. For these reasons my work must be done on material personally collected at Padova and environs (Brusegana, Montà, Vigodarzere, Abano, etc.) and in the Lagoon of Venice (Torcello, Punta Sabbioni, Cavallino, Treporti, Val Grassabò, Val Dragojesolo, Valle Averte, Chioggia, S. Giacomo, Casera Bombae, etc.) <sup>3)</sup>. The technic I used for microscopical examination was that pointed out by EDWARDS (1929), which in

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<sup>1)</sup> Principally THIENEMANN for Germany and Scandinavia, GOETGHEBUER for France and Belgium, KIEFFER for Germany, Scandinavia and Belgium, EDWARDS for Great Britain, and lastly LARB BRUNDIN for Sweden.

<sup>2)</sup> I started my investigations as far back as in 1939. Since then I have published the following papers: Osservazioni faunistiche e sistematiche sui Tendipedidi di Padova e Venezia, Mem. Accad. Scienze, Lett. Arti, Padova, 57, 1940-41, p. 5; Descrizione di tre nuove specie di *Smittia* della Laguna di Venezia, Boll. Soc. Ent. It., 77, 1947, p. 9; Note sui Tendipedidi alofili, Arch. Ocean. Limnol., yet to be printed.

<sup>3)</sup> A great contribution has been given by Dr. A. Giordani-Soika (Natural History Museum of Venice), who has carried out an exploration of a great part of the Lagoon and to whom I wish to express my appreciation.

my opinion gives the best result though a long and laborious one.

For the classification I followed the system of GOETGHEBUER and EDWARDS, searching to conciliate their divergent ideas. I must remark that I was not always able to obtain a definite determination, essentially because of the lack of the complete Bibliography and for the inability to examine any original types. For the Families and Subfamilies I follow the denominations of GOETGHEBUER (in LINDNER); for the species, when not indicated otherwise, I use the nomenclature (both specific and generic) as used by this author, or, if it is the case of a species not yet published in LINDNER, by GOETGHEBUER in "Faune de France". Concerning the genera, I did not consider it necessary to follow the amendments made by THIENEMANN and collaborators (e.g. within the old genera *Cricotopus* and *Smittia*), based exclusively upon the study of preimaginal characters. (See at this point what I say about the genus *Smittia* in: "Descrizione di nuove specie del bacino del Mediterraneo", to be published in *Annalen Mus. Wien*) <sup>1)</sup>.

It is a pleasure for me to thank all persons who helped me in some way in my work, particularly Dr M. GOETGHEBUER (Gand) who has revised some determinations of mine, Prof. MÜLLER and Prof. GRIDELLI of Natural History Museum of Trieste, who have allowed me to benefit from the collections and library of that Museum, and Dr M. BEIER of the Natural History Museum of Vienna, who sent me a specimen of *Tendipes carbonarius* from the Winthem collection for comparison.

## LIST OF THE SPECIES

### Pelopiinae (= Tanypodinae)

#### *Pelopia punctipennis* Mg.

Padova; Venezia, Mestre (on the road Mestre—Padova), Giordani Soika leg. (IV-XI).

Distribution: Germany, England, Austria, Belgium, France, Holland, Hungary, Finland, Scandinavia (GOET. II). N-America (MALLOCH).

#### *Procladius choreus* Mg.

Padova; Venezia(?), Moranzani(?), Giordani-Soika leg. (IV-V).

Distribution: Germany, England, Austria, Belgium, France, Holland, Russia, Scandinavia, Finland, Spain, Tunis, Anter. Asia (GOET. II), N-America (MALLOCH).

Variability: probably a very variable species. GOETGHEBUER (II, 10) says: "*P. culiciformis* scheint synonym zu *P. choreus* zu sein. Oft werden mit dem Namen *culiciformis* Exemplare bezeich-

<sup>1)</sup> My present position is a purely conventional one, since I have not accepted the systems of either one or the other.



net, die *P. parvulus* Kieffer sind, leicht kenntlich am Schildchen, dass hellgelb ist und am Mesonotum, das schwarzbraune, nicht bereifte Streifen hat." To notice that in this author's work of 1927 (in "Faune de France") *P. culiciformis* L. (= *fasciatus* Mcq.) should be synonym of *parvulus*. Thence *P. choreus* Mg. should be doubtfully syn. of *culiciformis* L., and *parvulus* syn. of *culiciformis* Goetg. 1927. The two species should be sufficiently distinguished by the hypopygium, the stylit showing some differences in the longitudinal axis of the two lobes. To be noticed that in GOETGHEBUER's works there is an incongruence about wing colour. In 1927 this author says: "Ailes un peu velues, hyalines, enfumées vers la pointe; les trasversales noires et bordées de noir", while in 1936: "Flügel schwach, gräulich getrübt in der Distalhälfte und mit einem sehr wenig deutlichen Fleck in der Analzelle". Also in the representation of the hypopygium there is a noticeable difference in these works of GOETGHEBUER's, but this can be due to the fact that the author in 1927 reports KIEFFER's original figure, when in 1936 the representation is based on KIEFFER's specimens (in THIENEMANN's collection).

The specimens examined by me show a darker colour than in the previous descriptions: wing markings more marked, darker legs, mesonotum almost wholly grey-blackish, except anterior angle, which is yellowish.

Note: a female has been classified as *P. choreus* by GOETGHEBUER.

*Anatopynia (Psectrotanypus) varia* Fab.

Padova (III-VI).

Distribution: Central Europe, France, England, Scandinavia, Russia, Holland, Belgium and Bulgaria (GOET. II).

*Ablabesmyia brevitibialis* Goet. sensu Edw.

Venezia, Mestre (VI).

Distribution: Belgium (GOET. II), England (EDW.).

*A. falcigera* Kf.

Padova, Vigodarzere (III).

Distribution: Austria, Germany, Belgium (GOET. II), England (EDW.), Sweden (L. BRUNDIN).

*A. monilis* L.

Padova; Venezia, Mestre (IV and VI).

Distribution: North and Central Europe, Island (GOET. II), N-America (MALLOCH).

## Diamesinae

### *Diamesa (Psilodiamesa) campestris* Edw. (?)

Padova, envir. (III).

Distribution: Belgium and England (GOET. II).

Variability: halteres, which in original description are "light to dark brown", are yellowish. Possibly the species is different from true *D. campestris*, though all remaining characters correspond perfectly to the description.

## Orthocladiinae

### *Metriocnemus fuscipes* Mg.

Padova, Abano; Venezia, Mestre (V-VI).

Distribution: Germany, England, Austria, Belgium, France, Holland, Scandinavia (GOET. II).

Variability: the male of Padova has a black shining mesonotum with yellow anterior angles and, anteriorly, with yellow longitudinal stripes. It can perhaps be referred to system of coloration of the typus of *M. deproperans* Wlk., which according to GOETGHEBUER is belonging to *M. fuscipes*, but according to EDWARDS is only doubtfully to be referred to the same.

### *M. hirticollis* Stag.

Padova (IV).

Distribution: England, Belgium, Russia and Scandinavia (GOET. II).

### *Cricotopus tricinctus* Mg.

Padova (IV-VI).

Distribution: France, Germany, Austria, England, Belgium, Scandinavia (GOET. II).

### *C. bicinctus* Mg.

Padova; Venezia, Mestre (in a garden with still, fresh water), Cavallino (along the road for Punta Sabbioni, brackish milieu) (IV-VI and VIII).

Distribution: France, Germany, Austria, England, Belgium, Scandinavia (GOET. II), N-America (MALLOCH).

### *C. trifasciatus* Pnz.

Padova (IV-VI).

Distribution: France, Germany, Austria, England, Belgium, Holland, Scandinavia (GOET. II), N-America (MALLOCH).

Note: the specimens from Padova have been classified by GOETGHEBUER.

*C. triannulatus* Mcq.

Padova (III and V-VI).

Distribution: France, England, Belgium (GOET. I), Sweden (KIEFFER, 1921, *Trichocladius suecicus*).

*C. sylvestris* Fab.

Padova (III-V).

Distribution: France, Germany, England, Austria, Scandinavia, Russia, Holland, Belgium, Island (GOET. I), N-America (MALLOCH).

*C. motitator* L.

Padova; Venezia, Mestre (III-VI).

Distribution: France, Germany, Austria, England, Scandinavia, Holland, Corsica (GOET. I).

Variability: some variations of colour are represented, which in my opinion have no genetical meaning and wherefor there is consequently no use denominating.

At this point I wish to observe that EDWARDS rightly considers *annulator* (known for Belgium and England) as a variation of *motitator*, and GOETGHEBUER himself (35) observes that the yellow marking of segment 2 of abdomen can be interrupted by a dark spot also in his *annulator*. This condition could possibly be interpreted as a link between the true *motitator* and *f. typ.* of var. *annulator*. As a matter of fact, in about 20 examined specimens there are some showing all the possible conditions of passage. At the same time the yellow markings of mesonotum can be limited to anterior angles, or extended on two longitudinal stripes which reach the basis after being confused. There is apparently no relationship between this markings and the extension of the dark spot on the segment 2 of abdomen. The following case of variability, in my opinion, is more interesting: light areas of abdomen show a silver reflex as in no other species of the group; that is perhaps a local variation, just like the *subcoeruleus* Edw. of England, of which the author says: "light areas of abdomen blueish-green instead of yellow". But the colour is the same in typical specimens. Besides, one of the 3 ♂♂ of Mestre does not show the dark spots on abdomen, characteristic of this species. Notwithstanding this fact I believe that it is always the case especially for *C. motitator*, for I found, together with this specimen, two others in which there are some spurs of dark coloration.

*C. biformis* Edw.

Padova (V).

Distribution: England (described by Radwell, Herts.).



*C. vitripennis* Mg. sensu Goetg. and Edw.

Venezia, Val Grassabò, Torcello, Punta Sabbioni (III-IV).

Distribution: France, England, Germany (GOET. I).

For the ecology, it has been amply referred in my paper on the halophil Chironomides.

Variability: mesonotum in ♀♀, yellowish with 3 short dark stripes, in ♂♂, yellow with 3 dark stripes, or dark with two yellow areas limited on anterior angles, or wholly blackish. Scutellum (♂) yellow as in ♀♀, or also dark. This variability, which I retain of continuous type, inherent an only subspecific entity, shows how much variable the species *vitripennis* is.

*C. halophilus* Kff. sensu Goet. I and Edw.

(= *C. prope halophilus* sensu meo 1941, *C. spec.* sensu meo in the work on halophil Chironomides)

Venezia, Punta Sabbioni, S. Giuliano, Fusina (VI-VIII) ; many other places of the Lagoon (Giordani-Soika, leg.).

Known from France, Germany, England, Norway (GOET. I).

For the ecology and systematics see my paper on halophil Chironomides.

*C. intersectus* Staeg.

Padova (III-VI).

Distribution: Scandinavia, Belgium, England, Island (GOET. I).

Variability: colour of tibiae from whitish (nearly half) to wholly brown-blackish. Transverse shining areas on the joints of the abdomen also variable, and to be referred (at least in some cases) to the being more or less ripe of the Insect.

Note: the difference between *tibialis* and *intersectus* should consist in the light colour of the tibiae more evident in the former, and in the shining areas of the abdomen more developed in the latter. I am convinced that such differences are very slight: rightly EDWARDS considers these two species as closely related by including *C. intersectus* in group "B", while for the system of coloration this species should belong to group "C".

*C. tremulus* L. (?)

Padova, 27.V.46, 1 ♂.

*C. tremulus* is known from France, Germany, Austria, England, Belgium and Scandinavia (GOET. I).

I attribute this specimen, which is in a bad state of preservation, very doubtfully to *C. tremulus*.

*C. brunnipes* Gthgh. (?)

Padova, 27.V.46, 1 male.

Known only from Belgium (GOET. I).

As for the species above mentioned, I am doubtful about the

determination of this specimen because of its state of preservation.

*Trichocladius* cfr. *rufiventris* Mg.

Padova, 5.II.39, 1 ♂.

*T. rufiventris* is known from England, Belgium and Germany (GOET. I). See what I say about this specimen in my note of 1941.

*Orthocladius* (*Chaetocladius*) *setilobus* n. sp.

♂ : black, with halteres and legs light brown. Mesonotum more or less shining, in some specimens only somewhat dull on the sides. Wings with dense microscopical points without any traces of microtrichia or of macrotrichia. Squama apparently bare. L.R. = 0.55, A.R. = 1.65. Hind legs with long hairs. Hypopygium: black, strongly sclerified, coxites rather long, with long and strong bristles on outer side, styles short and thin, somewhat curved before the apex, where they are provided with a black tooth not too long. Median lobe of coxite represented by a short eminence, just distally to the dorsal lamella, and provided with some strong bristles, a little longer than those of median side. Dorsal lamella (= dorsal joint) triangular, prolonged obtusely at the apex (fig. 1). Wing-length: 1.5 mm.



Fig. 1

Loc. class. Padova, 14-20.V.41, plur. ♂ ♂.

Belonging to group *femineus* Edw.-*nitidicollis* Gtgh.-*illimbatus* Edw., but different from the first by a well developed panache (antennae), from the second and the third by the structure of the hypopygium.

*Orthocladius confusus* n. sp. <sup>1)</sup>

♂ : small, yellowish. Anterior tarsi and tibiae more or less

<sup>1)</sup> In my previous paper of '41 I considered wrongly this species as "*prope rubicundus*".

darkened, antennal plume greyish, metanotum black, abdomen dark greenish, stripes on mesonotum reddish. Halteres light, wings bare, hyalin or only slightly milky, under reflexed light with purple reflexes. Squama with light hairs. An straight and surpassing f Cu, the last definitely distal to r-m, Cu<sub>2</sub> straight, anal lobe prominent, broadly rounded; A.R. = 1,1, ca., L.R. = 0.75. Eyes bare. No pulvilli present. Hypopygium: very characteristic for the median lobe on the coxite, which is slender, subtriangular, at the apex rather pointed, quite bare, at the proximal side more or less evidently concave, while distally it is straight or also convex (fig. 2).

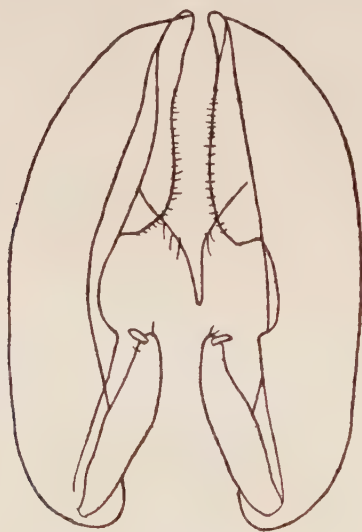


Fig. 2

Loc. class.: Padova, IV-V.41, plur. ♂♂ and ♀♀.

Belonging to group *hygropetricus* Kff. — *nivicola* Kff.

I have seen the original description of *nivicola* Kff. (Bull. Soc. hist. nat. Moselle, 30, 1924, p. 66) from Germany, but unfortunately there is no representation of the hypopygium, and what the author says of, is only vaguely to be referred to my specimens. GOETGHEBUER (in LINDNER) does not report *O. hygropetricus* even within synonyms, and the same is to be noted for *O. nivicola* in Faune de France. I do not believe, anyway, GOETGHEBUER to consider the two species as synonyms, for in this case he would indicate in LINDNER *O. hygropetricus* (described in 1911) in lieu of *nivicola* (described in 1924). To be noticed that KIEFFER compares *nivicola* with *hygropetricus*.



*O. italicus* n. sp.

Middle seized (mm. 3,5) ; black, mesonotum shining black, in some specimens strictly yellowish on anterior angles. Halteres dark (♂), in ♀♀ more or less light. Eyes bare. There are no microtrichia, but wings minutely and very densely pointed; membrana somewhat milky, under reflection with purple reflexes. An by far surpassing f Cu, this just distal to r-m, anal lobe very prominent (esp. ♂). A.R. = 1,7. Hypopygium: dorsal lamella prolonged in a slender point, median lobe of coxite prominent, irregularly subquadrangular (fig. 3).



Fig. 3

Loc. class.: Padova, Montà, 27.II.40, plur. ♂♂. Besides from Padova, II, 41 and from Abano (along the road Monteortone-Montirone), IV.41. (♂♂ and ♀♀).

Belonging to group "C" of Edwards (*O.s. str.*), but different from all species of this group by A.R., structure of the hypopygium and colour of halteres and mesonotum.

*Limnophyes italicus* n. sp.

♂: small. Blackish, mesonotum yellowish with 3 shining black stripes, at the basis rather confused. Antennae and wings like in *L. pusillus*. A.R. = 1,1. Hypopygium like in *pusillus*, but dorsal lamella with a point, rather long and triangular (fig. 4).

Loc. class.: Padova, 20.V.41, 1 ♂.

This new species of *Limnophyes* is surely very alike to *L.*

*pusillus* <sup>1)</sup> from which it is nevertheless different by the above mentioned characters.



Fig. 4

*L. minimus* Mg.

Padova (IV-V).

Distribution: England, Germany, Austria, Belgium, Holland, Scandinavia (GOET. II).

*Smittia edwardsi* Goetgh.

Padova, 14.V.41, 1 ♂ and 1 ♀.

Distribution: England (GOET. I), Sweden (L. BRUNDIN).

According to LARS BRUNDIN A.R. should vary from 1,8 to 2,16; in my specimens A.R. is 1,2 (see my paper of 1941).

*S. malarodai* mihi <sup>1)</sup>

Black, mesonotum entirely dull, antennal plume dark, legs black with dark and very long hairs (esp. on the hind limbs). Halteres brown-blackish (♂), wings milky with slight purple reflex. Costa and basis of the wing slightly yellowish, lobe obtuse, but distinguishable. L.R. = 0,5 A.R. = 2. Costa just surpassing  $R_4 + 5$ , which is slightly surpassing  $Cu_1$ ; fCu distal to r-m, An just surpassing f Cu and slightly bent towards posterior rand of wing. Hypopygium: dorsal lamella with a very short and delicate point, coxite provided with a lobe near the middle of median rand, of subtriangular shape and provided with some

<sup>1)</sup> In my paper of 1941 this species is wrongly considered as *L. pusillus*.

<sup>1)</sup> For the systematics of this species see the original description in Boll. Soc. Ent. It., 77, 1947, p. 9.

small short bristles. Style characteristic for a rather broad pre-apical expansion, which is distinguishable from the rest of the piece by the scarce sclerification (fig. 5). Length of the wing: 2 mm., of the body: 2—2,5 mm.

Loc. class. Torcello (Venezia), 16, III. 41, plur. ♂ ♂ (and ♀ ♀ ?).

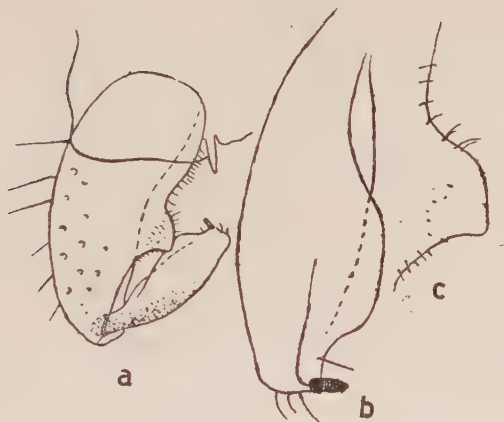


Fig. 5

*S. gridellii mihi* <sup>1)</sup>

Black, mesonotum slightly shining, abdomen black, except the hypopygium which is brown-blackish. Halteres (♂) wholly black. Legs and antennae (including the plume), brown-blackish. Abdomen and legs (esp. hind) with silver hairs, not too long. A.R. = nearly 2. Wing only slightly milky, under transmitted light with slight brown-purple reflex. Squama dark, but basis of the wing not darker than the rest of the membrana. An just bent at the extremity and slightly surpassing f Cu. Costa somewhat surpassing f  $R_4 + 5$  which is surpassing  $Cu_1$ .  $Cu_2$  definitely sinuated. Lobe very obtuse, therefor wing cuneiform. Alula slightly developed. Distance between 2 contiguous points = 1,25  $\mu$ .

Hypopygium: very simple. Basal lobe of coxite practically reduced to a slightly bent expansion provided with rather thin bristless (esp. on the cranial portion). Style slender, bent, rather pointed towards the extremity, where it is provided with a slender tooth very characteristic. There is no preapical expansion on the style (fig. 6). Length of the wing: mm 2.



Loc. class.: Venezia, Torcello, 16.III.41, plus. ♂ ♂.

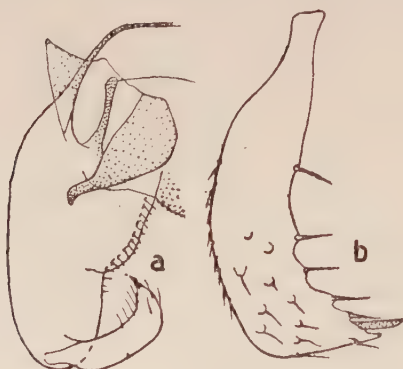


Fig. 6

*S. d'Anconai mihi* <sup>1)</sup>

♂ : Black, abdomen dull-black, hypopygium somewhat shining, brown. Mesonotum quite dull. Tasters and legs yellow-brownish, halteres brown-blackish, antennae yellow-brownish, plume very light. A.R. = 1,1. Legs with very light hairs, rather long on hind tarsi and tibiae. No pulvilli present. IV. joint of hind tarsus shorter than V. (IV : V = 0,79). Wings milky, at the basis not yellow (fig. 7, f). Hypopygium: characteristic for a particular development of dorso-ventral diameter, therefor dorsal lamella very convex. Coxite with two lobes, the basal more developed, slightly sclerified and densely provided with small, bent and short bristles, the apical one very small, strongly sclerified, hook-shaped, at the extremity very acutely pointed. Dorsal lamella without any point (fig. 7). Length of the wing: mm 0,96, of the body: mm 1,2.

♀ : Black, mesopleurae brown, halteres yellowish, antennae brown, with the last joint subcylindrical, on the extremity slightly acuminate and provided with some (3?) short very strong bristles; on the rest of the joint there are some bristles which are slightly bent (fig. 7, g). Last joint slightly shorter than the two precedent taken together. Wings milky though less than in ♂. Costa and basis of the wing slightly coloured with yellow. Legs lighter than in ♂, without the typical hairs of the ♂. Length of the wing: 0,95, of the body: 0,97.

Loc. class.: Venezia, Cavallino, along the road to Punta Sabioni, VII.39, plur. ♂ ♂ and 1 ♀.

<sup>1)</sup> For the systematics and ecology see my paper mentioned above.

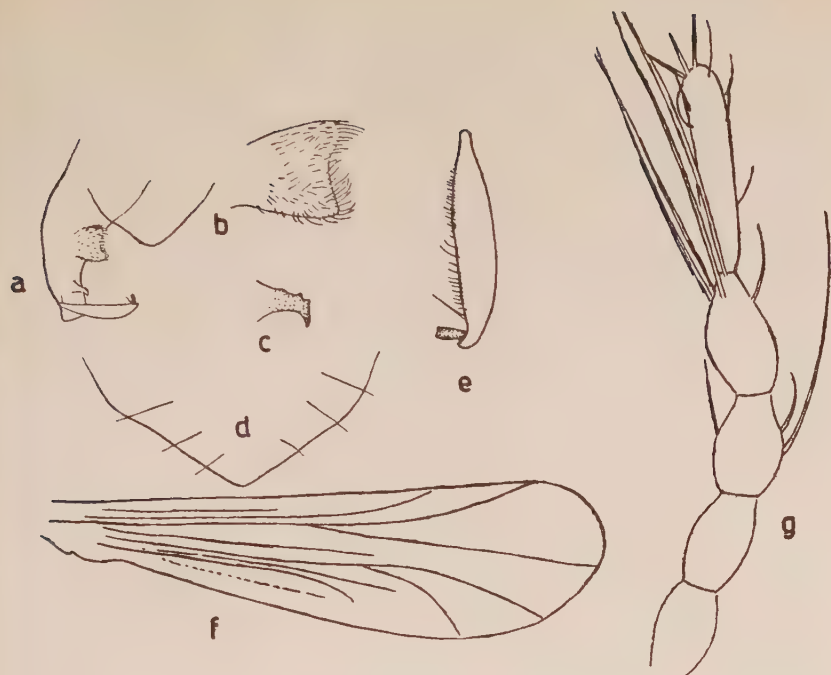


Fig. 7

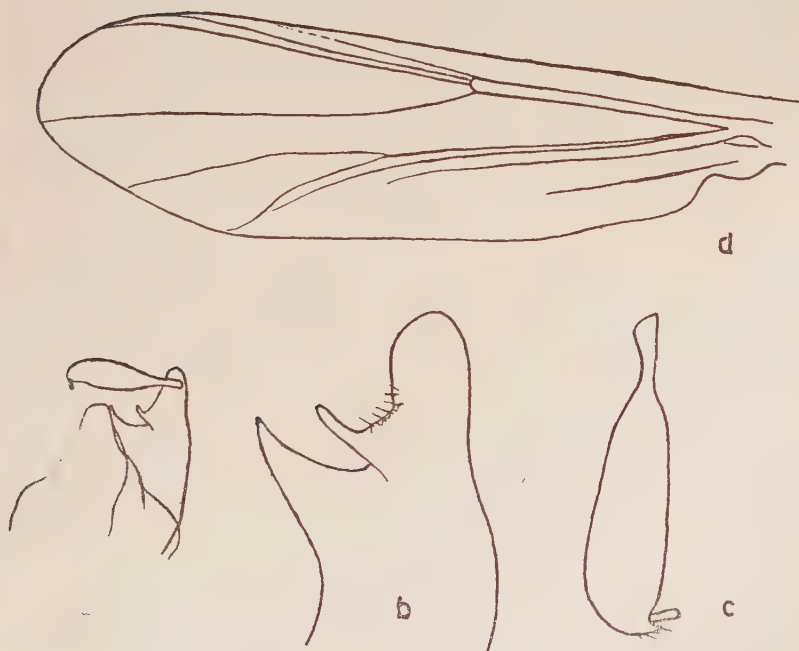


Fig. 8

*S. giordani-soikai* n. sp.

♂: Black, halteres whitish, legs yellow-brownish. Eyes bare. Squama wholly bare. Hind legs with very long, light hairs. Antennae: 14th joint shorter than 13 precedent; most of joints longer than broad. Antenna at the extremity provided only with some bent and very light short hairs. Radium (fig. 8, d) very characteristic:  $R_2 + 3$  is more marked than  $R_1$ , the latter being represented by a row of points and other structures of the membrana.  $R_2 + 3$  ending very near to  $R_4 + 5$  (almost as in *Eukiefferiella*). An ending in front of the end of f Cu. Anal lobe very slightly developed. Distance between two contiguous points on the membrana = ca.  $1.25 \mu$ . Pulvilli present. Hypopygium (fig. 8): characterized by the presence of two median lobes on the coxite, of which the basal larger, triangular and rather hook-shaped, the distal smaller, more slender and provided with some setigerous tubercles on the inner side. Style very strongly narrowed before the basis; dorsal lamella prolonged, but without any acute point. Length of the wing: 1.5 mm (the same for the body).

Loc. class.: Venezia, a small "barena" near to S. Giacomo, 14.V.44, leg. A. Giordani-Soika.

Systematics. Very doubtfully to be attributed to gen. *Smittia*. (As a matter of fact EDWARDS says that it is doubtful whether some species are correctly placed in this genus; see also MARCUZZI, in Ann. Museum Wien). According to GOETGHEBUER in Faune de France the new species should belong to subgenus *Pseudosmittia*, but according to EDWARDS' work it should be placed (for the presence of pulvilli and for the an ending front of the end of f Cu) between gr. "D" and gr. "E". At the same time the anal lobe is not well developed as it should be in EDWARDS' gr. "D". We are perhaps in front of a new subgenus, if not a genus.

*S. littorella* Gtgh.

Venezia, "Via Malamocco", leg. Giordani-Soika.

Distribution: Belgium (Knocke-sur-Mer) (GTGH. I).

*S. gracilis* Gtgh.

Padova, 14.V.41, 1 ♂. One specimen from Venezia (Lagoon, leg. Giordani-Soika) is to be ascribed with some doubt to this species.

Distribution: Belgium, England (GOET. I).

Somewhat doubtfully to be referred to *S. gracilis* because of the anal lobe, which in my specimen is entirely absent (as in other species of *Pseudosmittia*), while according to EDWARDS (1929, p. 362) it is obtusely rounded.



## Chironominae

### *Glyptotendipes spec.*

Venezia, Fusina, 1 ♀, leg. Giordani-Soika (in a bad condition of preservation).

### *Tendipes annularius* Mg. sensu GOETGHEBUER

Padova; Venezia: S. Giuliano, Fusina, Marghera, Dragojesolo, Cavallino, Punta Sabbioni (II-VIII), Marghera, S. Giuliano, Barena Vignole (leg. Giordani-Soika).

Distribution: Germany, England, Austria, Belgium, France, Holland, Scandinavia (GOET. II).

Variability. Of very variable size (esp. ♂ ♀). Mesonotum constantly with a grey pruinosity, with 3 longitudinal dark stripes, like in *T. cingulatus*. To be recorded that the examined specimens of this last species differ from *T. annularius* only by the absence of tarsal beard (anterior tarsi ♂). Actually, I did not see any transition of this character, but I wish to record EDWARDS' words about *T. cingulatus* "tarsal beard usually shorter, but in some specimens (as ZETTERSTEDT's type of *memoralis*) rather long". I am of the opinion that these two species are very strictly related and very badly distinguishable, at least with the criteria used so far by the authors.

For the ecology see my paper on halophil *Tendipedidae*. To be recorded that KRUSEMAN considers *T. annularius* as a facultative component of chironomidological fauna of brack-waters.

### *T. cingulatus* Mg.

Venezia, Valle Averte (leg. Gridelli), Punta Sabbioni, Cavallino, Chioggia (IV-V, VIII).

Distribution: Austria, Germany, England, Belgium, Holland, Russia, Scandinavia, France (GOET. II).

Variability: abdomen dark with transverse pruinose stripes on the joints. Mesonotum grey-pruinose with 3 longitudinal stripes a little darker (in not yet ripe specimens the ground colour is lighter, thence longitudinal stripes more marked).

For the ecology see the paper above mentioned.

Note: several of these ex. have been classified by GOETGHEBUER.

### *T. aprilinus* Mg. (nec Kieff., = *salinarius* Kieff.)

Venezia, Marghera and S. Giuliano, leg. Giordani-Soika, ♂ ♂.

Distribution: France, Belgium, Holland, Germany, England, Austria, Scandinavia, Island (GOET. II).

*T. dorsalis* Mg.

Padova; Venezia, Punta Sabbioni (along the road to Cavallino) (IV-VI).

Distribution: France, Germany, Belgium, Austria, Holland, Russia, England, Scandinavia, Island (GOET. II), Gulf of Marseille (TIMON-DAVID 1940) N-America (MALLOCH, *annularius* Mcq.).

For the ecology see the note above mentioned.

Note: several of these ex. have been classified by GOETGHEBUER, also as var. *riparius*).

*T. thummi* Kieff.

(= *riparius* Mg. sensu EDWARDS)

Padova, city and environs; Abano, on the wall of a reservoir with water at the temperature of 28° C., where I found also some larvae very probably belonging to this species); Venezia, Mestre, in a garden with still fresh water (II-VI).

Distribution: France, Belgium, Germany, Austria, Scandinavia, Italy (GOET. II).

Variability: rather constant habitus, with exception for some specimens coming from Mestre, which show a light greenish colour, with yellow-reddish markings; nevertheless the hypopygium of the specimens is identic to that of the others.

Synonyms: In GOETGHEBUER *I. thummi* is = ? *gregarius* Kf., while *riparius* Mg. is considered syn. of *subriparius* Kf., *annularius* Mcq., *viridipes* Mcq. For EDWARDS *riparius* Mg. (Goet.) is = *thummi* Kf. (without any indication of synonyms). GOETGHEBUER admits 2 species, *thummi* and *dorsalis*, without any indication of synonyms. At the same time *riparius* should be a variation of colour (insect revested with a grey pruinosity) of *dorsalis*. (To be noticed that in the work of 1928 of the same author there is no word about this pruinosity). Lastly in the work of 1932 GOETGHEBUER considers two *riparius*, one sensu Mg., a variation of *dorsalis* (and syn. of *subriparius* Kf., *curtibarba* Kf., *annularius* Mcq., *viridipes* Mcq., *helochares* Kf.) and another sensu KRUSEMANN, a syn. of *thummi griseus* Gthg. ("Thorax stark grau bereift; Mesonotalstreifen schwarzgrau; Abdomen schwarz, die hinteren Drittel der Tergite 2—5 in das Ende der drei letzter Tergite grünlich, grau bereift"). Besides, *thummi* should be a syn. of *gregarius* Kf., *pentatomus* Kf. and *indivisus* Kf.?

I believe therefore that EDWARDS wrongly considered *riparius* Mg. (Goetgh.) a syn. of *thummi* Kf. Anyhow only an examen of original types could permit a definitive synonymia.

Ecology: *T. thummi* is the most common *Tendipes* of Padova and environs, where it is living in the most various conditions, as running waters, or even reservoirs with standing water both

of eutrophic and "Sapropel"-type. Ecology and ethology of this species are very well known, since it is one of the most common species in Europe (apparently also in Italy), as well as very investigated upon for cytological purposes. In Italy it has been studied by MORETTI.

*T. plumosus* L.

Padova; Abano, Monteortone, on the wall of a reservoir with water at the temperature of 23° C. Apparently a very rare species in the territory.

Distribution: Germany, England, Austria, Belgium, Holland, France, Scandinavia, Russia, Siberia (GOET. II); desert of Kirghis (Kat. KERTÉSZ), N-America (MALLOCH).

*T. (Einfeldia) carbonarius* Mg.

Padova, 13-20.V.41, plur. ♂♂ and ♀♀.

Distribution: not yet known; Europe (Kat. KERTÉSZ), Sweden (L. BRUNDIN).

A very rare species since in Kat. KERTÉSZ only two authors (MEIGEN and WALKER) are reported. I did not see any original work, but I am of the opinion that this species is only known in Central Europe (Germany, England?) and, recently, in Sweden (LARS BRUNDIN). In LINDNER, though it is reported in the key of the group *Einfeldia*, it is absent in the list of the species, and the distribution is not indicated. It is not reported within the species of France.

Concerning the systematics, I wish to record EDWARDS' words about it: "I place three species (*longipes*, *dissidens*, *paganus*) here for convenience only; they do not seem to be very closely related, in spite of the similarity in form of the ♂ appendages". For THIENEMANN (followed by LARS BRUNDIN) *Einfeldia* is a genus. It is not in my knowledge if THIENEMANN has found any larval character to characterize this presumed genus: if it is not the case, in my opinion it is more advisable to maintain EDWARDS' systematics, according to which *Einfeldia* is a mere group (g. "B"). I must record that in my first note (1941) I have erroneously considered this species as "*Glyptotendipes* sp. inc. (sp. n.?)" because of a wrong valuation of a taxonomic character. Successively I have compared my specimens with one of the collection Winthem (Vienna) revised by GOETGHEBUER himself (Ann. Mus. Wien, 46, 1933).

*T. (Limnochironomus) notatus* Mg.

Padova (IV).

Distribution: Germany, Austria, England, Belgium, Holland, Scandinavia, Spain, Russia (GOET. II).



Variability: there is about the var. of GOETGHEBUER "*rufolineatus*", which is mentioned by EDWARDS without any specific denomination ("stripes generally red in ♂, black in ♀ — an unusual difference — sometimes black also in ♂").

*T. (L.) nervosus* Staeg.

Padova (VI).

Distribution: Germany, Austria, England, Belgium, Holland, Russia (GOET. II), Sweden (L. BRUNDIN).

Note: in Faune de France *T. nervosus* is considered different from *T. falciformis* Kf., which in LINDNER and in EDWARDS' work is on the contrary syn. of the former.

*T. (L.) venetus* n. sp.

♂: green (abdomen included); mesosternum, metanotum and longitudinal stripes on the mesonotum yellow-ochraceous, antennal scapum brownish, plume light yellowish. Halteres whitish, legs light greenish. Wings hyalin, r-m not darker than other nervatures. Hypopygium: characteristic for the structure of appendages. The superior is short, slightly broadened at the apex, where it is blade-shaped, acute, at the very extreme hook-shaped, bent medianly and provided with many thin bristles. Appendage inferior with two lamellar expansions (therefore bilobe), each of them provided with strongly bent hairs (fig. 9, a, gonopodes and appendages, b, dorsal lamella).

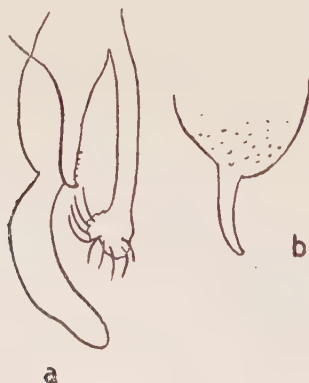


Fig. 9

Length of the body (♂): mm. 5, of the wing: 3,5.

Loc. class.: Venezia, Mira, on the road Mestre-Padova, 2 ♂ ♂  
leg. Giordani-Soika.

*T. (Cryptochironomus gr. Harnischia sensu Goetgh.)  
virescens* Mg.

Padova; Venezia, Fusina (IV-VII). Doubtfully coming from brackish water.

Distribution: Germany, France, Belgium, Holland, Austria, Scandinavia (GOET. II).

Variability: metanotum, sternum and stripes on the mesonotum light reddish, abdomen wholly light green (♂♂ and ♀♀). Hypopygium with spurs of the appendage I.a, style narrowed and bent at the middle, like in GOETGHEBUER's representation. To be noticed that GOETGHEBUER considers *T. virescens* as belonging to group *Harnischia*, in which there is no spur of appendages, and which in fact are not reproduced by this author (fig. 63,1). In my microscopic preparats the hypopygium shows a spur of appendage I.a, well visible only with inclusion in balsam (EDWARDS' technic). It is possible to my opinion that GOETGHEBUER was not able to discern this spur of appendage, or that in his specimens the same was not present.

To be recorded that my specimens have been classified by GOETGHEBUER himself as *virescens*.

*T. (Cryptochironomus gr. Parachironomus) varus* Goet.

Venezia, Mestre, towards S. Giuliano, fresh water with abundant flora (11.VI.41).

Distribution: Belgium, England, Holland (GOET. II).

*Polypedium nubeculosum* Mg.

Padova; Venezia, Osellino (leg. Gridelli), Mestre, in a garden with standing fresh water (III and V-VI).

Distribution: France, Germany, Austria, Belgium, Holland, England, Russia, Denmark (GOET. II), Sweden (L. BRUNDIN).

*P. prolixitarsis* Lundst. 1)

Abano, between Monteortone and Montirone, in water at the temperature of 20° C., i.e. a little superior to that of the other reservoirs, 17.IV.41, plur. ♂♂ and ♀♀.

Distribution: Germany, Curland, England, Belgium (GOET. II); described from Lapponia Fennica (LUNDSTRÖM, Acta Soc., Flora Fauna Fenn., 44, 1916, p. 8).

Variability: differs from original description by the seize (2 mm. while in typical specimens should be 4). The colour corresponds to the original ("Flügel ein wenig grauschillernd, fast glasshell... Die Adern sind bleicht und durchscheinend, die nicht verdunkelte Queradern liegt etwas vor der Mitte des Flügels").

1) Synonym of *P. pullum* Zett. according to LARS BRUNDIN, which has seen typical ex. of *P. pullum*. I believe that *pullum* s. Goetgh. is different from *pullum* s. BRUNDIN, since GOETGHEBUER (in LINDNER) considers *pullum* and *prolixitarsis* as two different species.

*P. quadriguttatum* Kff.

(= *scalaenum* var. sensu Goetgh. I)

Padova, together with *scalaenum*; Venezia, Mestre (V-VI).

Distribution: Germany, England, Belgium (GOET. II).

*P. scalaenum* Schr.

Padova; Venezia-Mestre (V-VI).

Distribution: France, Germany, Austria, Belgium, Holland, England, Scandinavia, Russia, Estonia, Palestina (GOET. II).

Concerning the systematics of this species and its relationships with *P. quadriguttatum* see my paper of '41.

*P. laetum* Mg. (?)

Venezia, "Via Malamocco", leg. Giordani-Soika.

Distribution: Germany, Austria, England, Holland, Belgium, Albania, Sweden (L. BRUNDIN).

*Kiefferulus tendipediformis* Gtgh.

Venezia, Mestre, in a garden with standing fresh water, 1 ♂.

Distribution: England, Belgium, Holland (GOET. II).

*Pentapedilum* spec. 2)

Venezia, Mestre, standing fresh water 11.VI.41 plur.

*Tanytarsus photophilus* Goet. (1928) 1)

Padova; Venezia, between Mestre and the city (V-VI).

Distribution: England, Belgium (GOET. I), Sweden (L. BRUNDIN).

*T. inopertus* Wlk.

Padova, Vigordarzero, along a channel with slowly running water (III).

Distribution: England, Belgium (GOET. II), Sweden (L. BRUNDIN).

Variability: Very variable. ♀♀ yellow-greenish, with abdomen slightly darker, mesonotum constantly with disjuncted red-brown stripes. ♂ olive-green, with tendence to blackish; mesonotum shining black with narrow anterior angles or, less frequently, wholly yellow-greenish with 3 dark longitudinal stripes. In my opinion this variability has no systematic significance.

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<sup>2)</sup> In my paper of '41 I wrongly classified this species as *Polypedilum pulum* because I failed to examine the hairs on the wings.

<sup>1)</sup> In my paper of 1941 I represented erroneously the appendage I.a, which is not "all'apice alquanto intaccata, quasi subtrifida", but quite identic to that represented by the authors.



*T. (s. str. sensu Goet.) manicus* Wlk.

Venezia; Marghera, "Canale dell'Osellino" (leg. Gridelli) (IV).

Distribution: Belgium, England (GOET. II), Sweden (L. BRUNDIN).

Note: these specimens have been classified by GOETGHEBUER.

*T. heusdensis* Gtgh.

Venezia, Mestre (VI).

Note. Doubtfully I attribute this specimens to *T. heusdensis* (known for Finland, Lettland, Holstein, Belgium and Sweden, according to L. BRUNDIN). GOETGHEBUER compares this species with *T. lactescens* Edw., which according to EDWARDS belongs to gen. *Tanytarsus*, subgenus *Tanytarsus*, series 2. As a matter of fact, I believe my specimens to belong to this section (that includes, according to EDWARDS, 9 species, of which 7 are described by him as new), but I cannot be sure of the classification, GOETGHEBUER also himself is doubtful whether considering *lactescens* a species or a varietas of *heusdensis* (mesonotum with black stripes).

## RESULTS

Since there are practically no faunistic notes concerning the *Tendipedidae* of Italy, it is very difficult to discuss the results of my investigations. Besides, I did not follow any quantative system of collection, nor did I make systematic researches from the ecological point of view. The results are therefore very isolated, and we cannot hope to get great benefits from a comparison with such different faunas as ours and north and central european faunas.

To begin with the components of the chironomidological fauna of the area in question, the species reported are about 57, of which only 40 surely classified. From these 57, not less than 9 should be new for the Science, and all of it new for the territory which I investigated <sup>1)</sup>. A comparison with other regions of Italy should be of no use, for the reasons mentioned above <sup>2)</sup>.

More interesting is a comparative examination of the distribution of the surely classified species, as results from the following table.

Within the 43 species considered nearly all are new for Italy, if we do not refer ourselves to old works of Italian authors,

<sup>1)</sup> CONTARINI reports from our territory the following species which I too found: *T. monilis*, *T. varius*, *C. plumosus*, *C. annularius* and *C. motitator*.

<sup>2)</sup> The only recent notes about some *Tendipedidae* of Italy one can see in some papers of MORETTI.

	North. Europe	Central Europe	Russia	South. Europe	North. Africa	Asia	North. America
<i>Pelopia punctipennis</i> . . . .	+	+	.	.	.	.	+
<i>Procladius choreus</i> . . . .	+	+	+	+	+	+	+
<i>Anatopynia varia</i> . . . .	+	+	+	+	.	.	.
<i>Ablabesmyia brevitibialis</i> . . . .	+	+	.	.	.	.	.
" <i>falcigera</i> . . . .	+	+	.	.	.	.	.
" <i>monilis</i> . . . .	+	+	.	.	.	.	+
<i>Metriocnemus fuscipes</i> . . . .	+	+	.	.	.	.	.
" <i>hirticollis</i> . . . .	+	+	+	.	.	.	.
<i>Cricotopus tricinatus</i> . . . .	+	+	.	.	.	.	.
" <i>bicinctus</i> . . . .	+	+	.	.	.	.	+
" <i>trifasciatus</i> . . . .	+	+	.	.	.	.	+
" <i>triannulatus</i> . . . .	+	+	.	.	.	.	.
" <i>sylvestris</i> . . . .	+	+	+	.	.	.	+
" <i>motitator</i> . . . .	+	+	.	+	.	.	.
" <i>biformis</i> . . . .	.	+	.	.	.	.	.
" <i>vitripennis</i> . . . .	.	+	.	.	.	.	.
" <i>halophilus</i> (?) . . . .	+	+	.	.	.	.	.
" <i>intersectus</i> . . . .	+	+	.	.	.	.	.
<i>Limnophyes minimus</i> . . . .	+	+	.	.	.	.	.
<i>Smittia Edwardsi</i> . . . .	+	+	.	.	.	.	.
" <i>gracilis</i> . . . .	.	+	.	.	.	.	.
" <i>littorella</i> . . . .	.	+	.	.	.	.	.
<i>Tendipes annularius</i> . . . .	+	+	.	.	.	.	.
" <i>cingulatus</i> . . . .	+	+	+	.	.	.	.
" <i>aprilinus</i> . . . .	+	+	.	.	.	.	.
" <i>dorsalis</i> . . . .	+	+	+	+	.	.	+
" <i>thummi</i> . . . .	+	+	.	+	.	.	.
" <i>plumosus</i> . . . .	+	+	+	.	.	+	+
" <i>carbonarius</i> . . . .	+	+	.	.	.	.	.
" <i>notatus</i> . . . .	+	+	+	+	.	.	+
" <i>nervosus</i> . . . .	+	+	+	.	.	.	.
" <i>virescens</i> . . . .	+	+	.	.	.	.	.
" <i>varus</i> . . . .	.	+	.	.	.	.	.
<i>Polypedilum nubeculosum</i> . . . .	+	+	+	.	.	.	.
" <i>prolixitarse</i> . . . .	+	+	.	.	.	.	.
" <i>quadriguttatum</i> . . . .	.	+	.	.	.	.	.
" <i>scalaenum</i> . . . .	+	+	+	.	.	+	.
" <i>laetum</i> (?) . . . .	.	+	.	+	.	.	.
<i>Kiefferulus tendipediformis</i> . . . .	+	+	.	.	.	.	.
<i>Tanytarsus photophilus</i> . . . .	.	+	.	.	.	.	.
" <i>inopertus</i> . . . .	+	+	.	.	.	.	.
" <i>mancus</i> . . . .	+	+	.	.	.	.	.
" <i>heusdensis</i> (?) . . . .	+	+	.	.	.	.	.

whose data are too incomplete to be of any great help, and to my previous papers mentioned above, 36 are new for South-Europe.

The most of the components are widely diffused ones, and precisely: 34 species common to north and central european faunas, (therefore only 9 reported so far from Central Europe). None are to be found only in Northern and not in Central Europe. And one could expect results like these. The largest range of diffusion is represented by 3 species (*Procladius choreus*, *Tendipes plumosus* and *Tendipes dorsalis*). Not one of the species considered by EDWARDS as cosmopolitan has been seen. I have no knowledge about the presence of endemismes within the *Tendipedidae*. GOETGHEBUER and TIMON-DAVID (1939), referring themselves to the species collected in the gulf of Marseille, are of the opinion that the new species "may even be endemismes". Within the new found species in our territory, some of the ones found in marin milieu could be endemismes, but we have no real foundation to consider any species of *Tendipedidae* as an endemism.

Concerning the distribution of the single entity referred to the pH of the milieu, an examination of water from a reservoir from which is coming the greater part of the species of Padova, has given  $pH = 7,8$ . Comparison between my data and those of GOETGHEBUER (1936) on some waters of Belgium reveal: *Polypedium prolixitarse*, characteristic for the "Hautes Fagnes" (with *Sphagnum* and acid reaction) has been found by me only in one place (Abano, along the road Moenteortone-Montirone); another species inhabiting acid waters ("Campine, Belgium), *Tendipes dorsalis* v. *viridicollis* v. d. W., has been found by me (*f. typ.* and *v. riparius*) together with *T. thummi* and many other *Tendipedidae*, not one of which appear to be in the acid waters of Belgium. (It should perhaps be interesting to demonstrate if *v. viridicollis* of *T. dorsalis* is a peculiar adaptation to pH).

The following species are common to alcaline waters of Belgium (GOETGHEBUER) and the waters of the environs of Padova and Venice:

*Psectrotanypus varius*, *Ablabesmyia monilis*, *A. brevitibialis*, *A. falcigera*, *Procladius choreus*, *Tanypus punctipennis*, *Polypedium scalaenum*, *Chironomus notatus*, *C. nervosus*, *C. thummi*, *C. plumosus*, *C. dorsalis* (and var. *riparius*), *C. annularius*, *C. varus*, *Kiefferulus tendipediformis*, *Tanytarsus heusdensis*, *T. mancus*, *Metriocnemus fuscipes*, *Cricotopus tricinctus*, *C. trifasciatus*, *C. bicinctus*, *C. triannulatus*, *C. motitator*.

Concerning the subdivison between still and running waters and its relationship to the chironomidological fauna, we have made no specific observation. However, from the species reported by GOETGHEBUER for the running waters of Belgium only a few (*Polypedium quadriguttatum*, *Tanytarsus inopertus*) have been found by me, together with species typical of still waters. (It is

Common to Padova and Venice <sup>2)</sup>	Padova only	Venice only <sup>1)</sup>
<i>Procladius choreus</i>	<i>Anatopynia varia</i>	<i>Ablabesmyia brevitibialis</i>
<i>Pelopia punctipennis</i>	<i>Ablabesmyia falcigera</i>	<i>Glyptotendipes spec.</i>
<i>Ablabesmyia monilis</i>	<i>Diamesa campestris?</i>	<i>Tendipes varus</i>
<i>Tendipes annularis</i>	<i>Tendipes plumosus</i>	<i>cingulatus</i>
<i>dorsalis</i>	<i>thummi</i>	<i>venetus</i>
<i>virescens</i>	<i>carbonarius</i>	<i>aprilinus</i>
<i>Polypedilum nubeculosum</i>	<i>notatus</i>	<i>Polypedilum laetum</i>
<i>quadriguttatum</i>	<i>nervosus</i>	<i>Kiefferulus tendipediformis</i>
<i>scalaenum</i>	<i>Polypedilum prolixitarse</i>	<i>Tanytarsus mancus</i>
<i>Tanytarsus photophilus</i>	<i>Tanytarsus inopertus</i>	<i>heusdensis(?)</i>
<i>Metriocnemus fuscipes</i>	<i>Metriocnemus hirticollis</i>	<i>Cricotopus vitripennis</i>
<i>Cricotopus bicinctus</i>	<i>Cricotopus tricornis</i>	<i>halophilus(?)</i>
<i>motitator</i>	<i>trifasciatus</i>	<i>Smittia malarodai</i>
<i>triannulatus</i>	<i>intersectus</i>	<i>d'anconai</i>
<i>Smittia gracilis(?)</i>	<i>sylvestris</i>	<i>gridellii</i>
	<i>biformis</i>	<i>giordani-soikai</i>
	<i>tremulus (?)</i>	<i>littorella</i>
	<i>brunnipes(?)</i>	
	<i>Trichocladius cfr. rufiventris</i>	
	<i>Orthocladius setilobus</i>	
	<i>confusus</i>	
	<i>italicus</i>	
	<i>Limnophyes minimus</i>	
	<i>italicus</i>	
	<i>Smittia edwardsi</i>	

<sup>1)</sup> Species coming from brackish or sea water are indicated with a +.



not impossible that the larvae of these two species were living in places provided with running water). For the problem of the adaptability to brack, or sea-water conditions, I have already exposed the data concerning the Chironomides of Venice in my paper previously mentioned. The following table only a list of the species distributed according to their habitat in the investigated region <sup>1)</sup>.

Another chapter of the knowledges about the chironomidological fauna of our region is phaenology.

Although no organic researches have been carried out, we can affirm that the number of the species is increasing from February to get a maximum in May and June, after which it is decreasing rapidly. During the summer the most represented (both quantitatively and qualitatively) are the species inhabiting the Lagoon. There are no sufficient dates to establish the quantitative behaviour of the species during the autumn.

Concerning the number of represented Subfamilies and genera we can establish the following: the most represented are the *Orthoclaadiinae*, followed by the *Chironominae*, and then the *Tanypodinae*, according to the total number of the respective components. From the *Diamesinae* I found only one species (*D. cfr. campestris*), and may be this penury is due to the northern diffusion of the group and its living in mountainous regions. No *Corynoneurinae* or *Clunioninae* have been found. (Very probably in the Lagoon of Venice there must be some representative of the latter, but it is possible that the only places inhabited are at the outer side of the Lagoon).

The following genera are represented <sup>1)</sup>: *Pelopia*, *Procladius*, *Psectrotanypus*, *Ablabesmyia*, *Diamesa*, *Metriocnemus*, *Cricotopus*, *Trichocladius*, *Orthocladus*, *Limnophyes*, *Smittia*, *Tendipes*, *Polypedium*, *Kiefferulus*, *Pentapedilum*, *Tanytarsus*.

This number is rather small, if compared with that of the representants in north and central European faunas. But one must not forget that the milieu examined is rather uniform, apart from the sea or brackish water of the Lagoon, and that sufficient researches have not quite been done.

A comparison between our fauna and that of Northern and Central Europe would not yet be possible, nor opportune. Only in a preliminary way we can affirm that the particularly represented genera are: *Smittia*, *Cricotopus* and *Polypedium*. Within *Chironominae* bare-winged genera prevail on hairy-winged ones.

<sup>1)</sup> There are not included some species of *Cricotopus* (gr. "A" and "B" of EDWARDS') of which I have seen only ♀ and coming from many localities of the Lagoon (both with fresh, or brackish, water and with sea water).

<sup>1)</sup> I use, as previously said, the classification of GOETGHEBUER II and EDWARDS. By accepting TIENEMANN's ammendments, the number of the genera should be somewhat increased.

Perhaps this equilibrium between bare and hairy winged *Chironomidae* (as that one noticed by THIENEMANN and by this author referred to eutrophic resp. oligotrophic conditions of the water) is due to environmental factors (pH, e.g.), but presently I have no sufficient dates to affirm anything about it.

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# Remarks on *Microgromia socialis* Hertwig et Lesser

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On 16 March 1946, while studying the microlife in a fish-pond at Enschede, I came across a rich population of a *Microgromia spec.* Hundreds of exemplars were living together between dead submersed gras-stems on what seems a fixed spot of the margin.

The fish-pond is eutrooph, mesosaproob, pH 4,9—5, Cl. 26,6 mgr. pro L, the temperature on that date was 3,5° C.

Apparently the species in question was *Micr. socialis* HERTW. et LESSER but there were some details, which I thought worth for a more closer examination.

Those, who study *Rhizopods*, are with no doubt acquainted with the excellent study of HERTWIG in "Archiv für Mikroskopische Anatomie", Band 10, Suppl. 1874, on *Microgromia socialis*.

This study is an example of fine observation and clear description, the more welcome as the species seems rare.

Neither PENARD nor HOOGENRAAD and DE GROOT ever met with this interesting *rhizopod*.

CASH, describing it, criticizes the figure of ARCHER in "Qrt. Jrn. Microsc. Sci." 1869, Pl XXII, (agreeing with the figures of HERTWIG), but we on our turn studying the figures of CASH don't consider his poor figures a progress in comparison with those of HERTWIG and ARCHER. The pity of it is, that the figures and the diagnose of HERTWIG don't agree with each other in every respect. There is an incongruity, not cleared up by the figures of CASH, we are missing here the clearness of a PENARD.

It is very difficult to make clear the situation of the aperture of the test, being the transparency of the test and its thinness a great hindrance for a just observation.

The aperture is not placed terminally, as says CASH, but the aperture has an oblique and lateral position.

Neither the figures of HERTWIG nor those of CASH and ARCHER show us the aperture on the right place or in the right form.

The figures of HERTWIG show a test with a broad, terminally placed aperture (see fig. 3a and 3b), CASH mentions besides a "short neck", a neck clearly demonstrated by *Microgromia elegantula* PENARD.

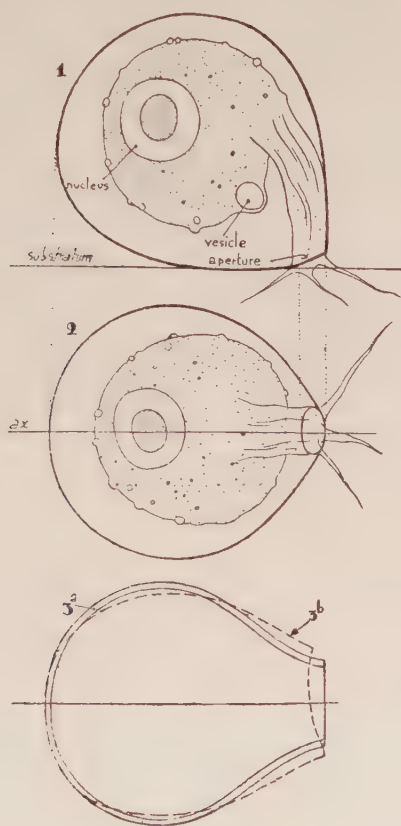
Finally HERTWIG draws the test with a thickness of 1,5—2  $\mu$ , which is far more than in reality is the case.

I suppose after a careful study of many individuals, that the



figures of HERTWIG, CASH and ARCHER as for the test are not properly represented.

I hope, that the following description and the figures, made after the fresh material, will make this clear.



The test is hyaline, smooth and extremely delicate, with a thickness not surpassing  $1\ \mu$ , dorsoventral, bilateral, nearly spherical and somewhat irregular or ellipsoid, aperture circular, lateral and obliquely situated, not terminal.

Diam. of test  $26-30\ \mu$  (HERTWIG  $13,5 \times 16,4\ \mu$ , CASH  $25-35\ \mu$ ), aperture circa  $5-6\ \mu$ .

Plasma bluish, granular, containing here and there refringent globules of variable size, nucleus comparatively large —  $11\ \mu$ , with a single bluish nucleole.

The irregular spherical plasmic body fills normally the test but for a part (seldom totally), arising sideways from the plasmic body is a characteristic long, wrinkled peduncle, deflecting to

the wall of the test towards the aperture and emanating in fine, not anastomosing filopodia, but few in number.

Sometimes the peduncle flows out of the test, forming a broad plasmic expansion with short pseudopodia. The plasmic body shows numerous wart-like protuberances.

Near the peduncle is a contractile vesicle. The part of the plasmic body directly beneath the peduncle is coloured brown or green with food-remains.

The plasmic body also appears differentiated in a part, where the food is digested in food-vesicles and in an other part always colourless. It may be that the food is in the main chlorophyllous.

The food is attracted by the filopodia and directed slowly to the aperture, where it usually remains for a long time against the test, the food consisting in this case of *Chrysococcus punctiformis* PASCHER, *Diatomaceae*, *Chlamydomonadaceae*.

*Diatoms* with a length equal to the diameter of the test were captured and digested.

Multiplication was done only by transverse division of the plasmic body and completed within the test.

The individuals, in division were colourless, without food remains. In a single case I saw an individual, which was probably encysted (see Plate I, fig. 6).

Colonies or groups were not observed, in all cases the individuals were in a solitary form.

My conclusion is, that the figures of HERTWIG, ARCHER and CASH are misdrawn and don't give a clear outline of the test. In disbelief, that there exist forms with an aperture of about half the diameter of the test as HERTWIG shows us (see fig. 3a and 3b).

Especially "aperture terminal" as CASH mentions, seems incorrect. Apparently is this due to an optical delusion.

There is no neck in the proper sense. As for the other characteristics, there are interesting differences with the description of HERTWIG, e.g. the absence of aggregations of any sort, the not anastomosing filopodia and the manner of feeding.

Is the solitary living of little diagnostic value and the not anastomosing filopodia perhaps due to milieu circumstances, the manner of feeding seems of more importance.

HERTWIG tells us, that the form studied by him was feeding on colourless food and that there was no pigment found by the metabolic process. Seldom, as he mentions, were reddish or yellowish granules to be seen in the plasmic body. Spores of *Algae* were seldom captured but, as he expressly said, this was a rarity.

The form, studied by me, was very active and every moment to be seen capturing some food as mentioned above.

Apart from this, anything fits easily with the description of

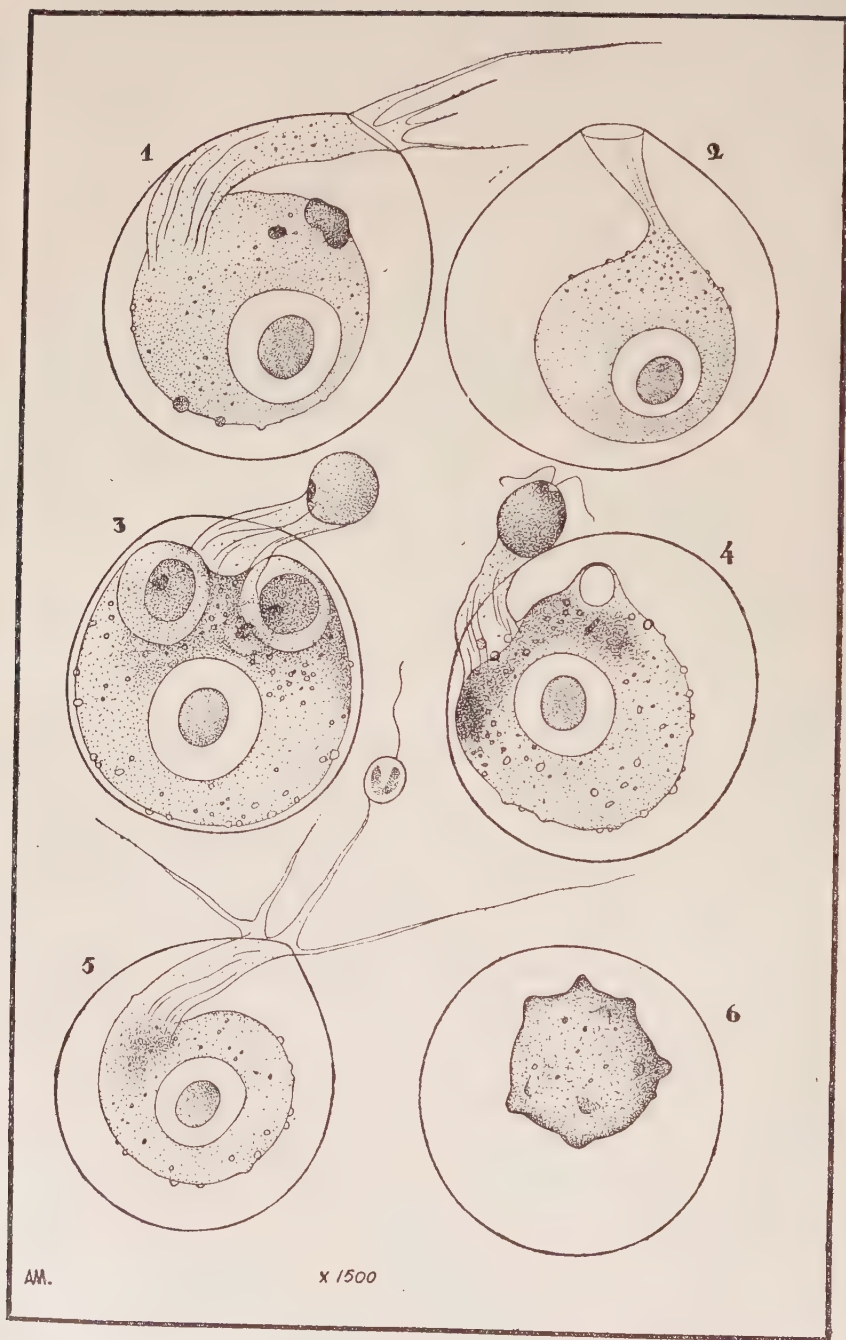
HERTWIG's *Microgromia socialis*, and it seems unnecessarily to make a variety of the form I met.

It is probably due to the hyaline test and the minute size, that this interesting species is so seldom found, it is easily overlooked.

- Fig. 1. *Microgromia socialis*, side view. (orig.)  
„ 2. from above (orig.)  
„ 3. Two tests, enlarged on the same scale, after HERTWIG, showing the broad aperture.

#### PLATE I

- Fig. 1. Active individual, lateral view.  
„ 2. Individual, ventral view.  
„ 3. Active individual with food vesicles and capturing a *Chlamydomonas spec.*  
„ 4. Active individual with contractile vesicle, capturing a *Chlamydomonas spec.*  
„ 5. Active individual capturing a specimen of *Chrysococcus punctiformis*.  
„ 6. Encystment?
- Figures enlarged x 1500.





# A new limnological method for the Investigation of thin-layered epilithic communities

by

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## INTRODUCTION

The study of thin-layered algal communities has always been a very difficult and troublesome one. Different authors (BUTCHER 1932, IVLEV 1933, GODWARD 1934, 1937) have introduced the use of glass slides, which, after remaining a time under the water, are picked out again and microscopically investigated. The method is not suitable for an extensive survey of a very large country rapidly travelled. Moreover, it is very likely that the communities that become fixed upon the slides may be different from those found in natural biotopes. It is a pressing need to find a more suitable method for the research of those thin layered communities. I have obtained very satisfactory results in the application of a method suggested by BUSCALIONI and POLLACCI (1901, quoted by WENZL) and developed by WENZL (1940, 1941) for the research of superficial topography of leaves and epiphytic fungi. The "collodium-film" method has been used too by the author in the study of soft tertiary lacustrine sediments. The *modus operandi* for the study of epilithic communities is as easy as efficient, and will be described in the following lines.

## TECHNIQUE

Little stones or suitable fragments of larger rocks, preserved in formaline solution, are stained with Delafield's haematoxyline. After careful washing with distilled water, they are allowed to pass through the series of alcohols, and they are finally transferred to absolute ethylic alcohol mixed with ether. The whole process, starting from the preserved material is ready in half a day. The stones are picked out of the bottles or tubes and without waiting for them to be completely dry, a little quantity of collodium, dissolved in alcohol plus ether, is dropped upon them. Then, the stones are allowed to dry completely; the dissolvent evaporates in few minutes. With pointed forceps the solidified collodium film formed in the surface of the stone, that includes the

epilithic vegetation, is pulled off. It is not easy, but not necessary either, to obtain very large stripes of the films. Breaking the stone at the opposite side of the suitable surface is often useful to obtain particularly large pellicles. The fragments of the film are then mounted, taking into consideration that it is desirable to conserve the original position of the sample: the side directed to the stone should be directed to the slide. The cover is then applied, avoiding air burbles. In good dehydrated material the films may be directly mounted in canadian balsam. Such a suitable dehydration is easy to obtain in fossil dry material, but is not so rapid in the submerged stones. It is advantageous to renounce to the balsam and to the unpleasant "clouds", so frequent in routine work, and to mount the collodium films in one of the sirupous fluids used by entomologists, whose principal constituents are hydrated chloral, arabic gum and glycerine (for ex. HOYER's formula). The preparations are almost as satisfactory and save more time than the balsam mounts. Of course this method may be applied in the study of submerged roots, weeds, snails, caddish-fly larvae, etc., searching for epibionts.

## RESULTS

A very faithful image of the surface of the stone, including the complete epilithic vegetation, is obtained, and statistical accounts are easy and secure. I have tested to obtain new films of "used" stones, and I have already proved that the first film takes out all the epilithic vegetation. These epilithic communities are formed chiefly by bacteria, fungus, diatoms, green and blue algae. Organic substances adherent to the stones are also present: mucous sheaths and coverings and absorbed organic matter.

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## Personalia

Dr H. C. REDEKE

29 VIII 1873—10 IV 1945

Dr REDEKE was born in Amsterdam, and there got his primary, his grammarschool and University education. In his youth already he was an enthusiastic collector of plants and insects. He studied at the University of Amsterdam in the period of many celebrities in the faculty of Science: MAX WEBER, HUGO DE VRIES, VAN 'T HOFF, VAN DER WAALS and MOLENGRAAF were among his tutors.

In 1896 he was made a Bachelor of Science. He made a study of gallnuts under HUGO DE VRIES. He finished his studies in 1898 with his doctors thesis: *Onderzoekingen betreffende het Urogenitaalsysteem der Selachiers en Holocephalen* (Investigations on the urogenital system of Selachians and Holocephalians). In 1896 and 1897 REDEKE was a temporary assistant to Dr P. P. C. HOEK at the Zoological Station at Den Helder and in 1898 he became a permanent assistant. Here he worked on his thesis. In 1900 he visited the Zoological Station at Napels with the object of studying the mucous membrane of stomach and intestine of sharks and rays and the macroscopical structure of their intestinal tract.

After the departure of Dr P. P. C. HOEK to Copenhagen, Secretary to the "Conseil Permanent International pour l'Exploration de la Mer", REDEKE in 1902 was appointed scientific adviser of Fisheries and supervised the part the Netherlands took in the investigation of the sea. In 1903 he became Director of the newly founded Government Institution for the Investigation of the Sea. This institution had its headquarters at the Zoological Station at Den Helder. In 1902 REDEKE had been appointed also Director of the Zoological Station. Zoological students worked there for a shorter or longer period and profited by REDEKE's assistance. During this period the Library increased considerably, a new catalogue was made by him.

On board the Dutch research-vessel the "Wodan", he participated in the investigations of the North Sea, especially on growth, food and spawning-grounds of plaice and other fishes. From 1904—1912 he assisted as an expert at the meetings of the Conseil Permanent, from 1913—1925 as a delegate of the Dutch Government. In 1912 and 1920—1922 he was Chairman of the Plaice Committee, and in 1920 of the Limnological Committee of the Conseil Permanent International pour l'Exploration de la Mer. During this period he published many articles in the *Bulletin* and *Rapports et Procès verbaux* of the Conseil, and his inter-



national reputation as Fishery Expert was established.

He was not only interested in fishes, but in plancton as well. He studied the plancton of the Easter Scheldt, while he was awarded a gold medal for his publication: *Plankton-onderzoekingen in het Zwanenwater bij Callantsoog*. (Plancton-investigations in "Het Zwanenwater" a little lake in the dunes near Callantsoog).

In 1922 REDEKE was invited to the foundation-meeting in Kiel of the Internationale Vereinigung für theoretische und angewandte Limnologie (I.V.L.) and until 1943 represented the Netherlands in this society.

From 1898—1914 he assisted Dr HOEK in supervising the turning out of salmon-fry in the German part of the Rhine and its siderivers to increase the salmon-production of the Dutch part of the Rhine. After the death of Dr HOEK in 1914 he was appointed "Gevolmachtigde voor Nederland volgens artikel X van het Zalmtractaat" and in this function he had the management of the above mentioned improvement of the salmon-stock in the Netherlands. He visited and studied many barrages and fish-traps in Belgium, Germany and Switzerland.

In 1916 the Government Institution for the Investigation of the Sea was split up into a Government Institution for Biological Fishery Research and one for Hydrographical Fishery Research. He was appointed Director of the first. During World War I researchwork on the North Sea was impossible and fishery research in the Netherlands specialized on freshwater. For that purpose REDEKE had to fit out a floating laboratory. With this ship "De Meerval" a great many waters in different parts of the Netherlands were investigated, and research on growth of fishes and their food, on plancton and other living organisms of the rivers, lakes and canals of our country, most of them brackish waters, was done by REDEKE and his assistants.

From 1916 on, he lectured at the University of Amsterdam, his first lecture dealing with "Plankton en Visscherij". He taught Hydrobiology and Pisciculture and, on account of his enthusiastic, clear and captivating lectures, he made his own school of Hydrobiologists.

One of our greatest brackish waterareas the Zuiderzee, had his special attention. The Netherlands Zoological Society took the initiative for investigating this inland sea regularly. REDEKE had the supervision of this research work. The results of this work was published under his editorship in 1922 in: *Flora en Fauna der Zuiderzee, Monografie van een brakwatergebied*", followed in 1936 by a supplement.

In 1929 the Government Institution of Biological Fishery Research moved from Den Helder to Gouda and thus REDEKE's Directorship of the Zoological Station ended. In 1933, for reasons of economizing, the Government dismissed him and in 1938 at



the age of 65, he was pensioned off.

In 1934, Dr REDEKE settled at Utrecht, and there carried on privately his researchwork. Many publications appeared right up to his death. In the meantime he was scientific assistant to the Library of the University of Utrecht and helped reorganizing the catalogue of Natural History and Medicine.

The results of his many investigations on fishery and hydrobiology are contained in 265 publications from 1896 to 1943. A list of these is given in: Archives Néerlandaises de Zoologie, Tome VII, Supplement, Mai 1946.

Dr REDEKE's lifework was a book on the Hydrobiology of the Netherlands, his last years being devoted exclusively to this. Unfortunately, it has not been possible for him to finish it as the war deteriorated his bad health. He died on April 10, 1945. One of these days the finished part of his book: "Hydrobiologie van Nederland" was published posthumely. It also contains the references to all his publications.

The summary of Dr REDEKE's scientific life may be given in the words of one of his admirers at the celebration of his 70th birthday:— work, finish, publish.

A. P. C. DE VOS.

## Emile DE WILDEMAN comme Algologue

Le 24 juillet 1947 est mort à l'âge de 81 ans EMILE DE WILDEMAN.

Cet homme qui a débuté comme pharmacien est devenu un des plus grands botanistes belges. Durant toute sa vie EMILE DE WILDEMAN a déployé une activité sans égale. Le bibliographe qui se proposera de dresser la liste complète des publications de ce savant, se trouvera devant une tâche ardue, car il ne sera jamais certain de n'avoir passé une publication sous silence.

Outre un grand nombre de travaux personnels, EMILE DE WILDEMAN a publié une quantité de comptes rendus, de critiques, de notes de toutes espèces dans de multiples revues de tous genres.

Né à Saint Josse ten Noode (faubourg de Bruxelles) le 19 octobre 1866 il suivit d'abord les cours de l'Athénée de sa ville natale, puis ceux de l'Université libre de Bruxelles où, en 1887 il obtint le diplôme de pharmacien et, en 1892, celui de docteur en sciences naturelles.

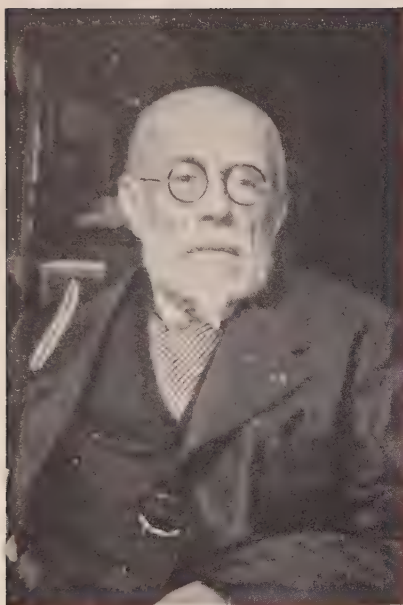
Il fut successivement assistant du grand physiologue le Prof. ERRERA, puis professeur à l'Ecole supérieure de Commerce, annexée à l'Université de Gand où il donnait le cours de cultures coloniales; professeur à l'Ecole coloniale supérieure d'Anvers et directeur du Jardin botanique de l'Etat à Bruxelles de 1912 à 1931.

Au début de sa carrière de botaniste, DE WILDEMAN s'est spécialement intéressé aux Algues. Il étudia le matériel rapporté par MASSART des Indes néerlandaises. Après avoir dressé un Prodrôme des Algues de ces régions, il constitua une flore des Algues de Java, publiée sous le titre de „*Flore des Algues de Buitenzorg*”.

Une liste de ses travaux algologiques (comprenant 154 numéros) a paru dans le livre de FR. EVENS: *Geschiedenis der Algologie in België* (1944) publiée par la „Koninklijke Vlaamsche Academie voor Wetenschappen, Letteren en Schoone Kunsten van België”. Si l'on se rappelle que l'oeuvre de DE WILDEMAN sur les phanérogames est encore plus imposante, on peut se rendre compte du travail considérable qu'a réalisé cet éminent botaniste.

Nous ne nous occuperons ici que des Algues. Dès 1885, le jeune étudiant en pharmacie fait paraître de courtes notes intitulées: „*Contributions à l'Etude des Algues de Belgique*” dans le „Bulletin de la Société royale de Botanique de Belgique”. Ce sont de simples notes floristiques, de 2 à 10 pages petit format. Elles n'ont d'autre mérite, que celui de s'occuper d'une groupe peu en honneur en Belgique à cette époque, si l'on excepte les Diatomées magistralement étudiées par HENRI VAN HEURCK.

Puis DE WILDEMAN s'occupe de problèmes se rapportant à la composition chimique, à la morphologie et à la division cellulaire des Algues. Mais l'étude systématique et floristique des Algues le



Emile de Wildeman





préoccupe le plus. Les genres *Ulotrix*, *Trentepohlia* et les *Desmidiées* captivèrent surtout son attention. Il étend son champ de recherches sur les algues et il publie ses études dans des revues de plus en plus nombreuses. Certains travaux paraissent dans des revues étrangères comme „La Notarisia” les „Annales du Jardin botaniques de Buitenzorg” où, en 1891, il publie un travail sur les *Trentepohlia* des Indes néerlandaises. En 1896 paraît son grand travail: „*Flore des Algues de Belgique*” que la Société royale de Botanique de Belgique a doté du prix CRÉPIN pour l'année 1896.

Seule la „*Flore cryptogamique des Flandres*” de KICKX, parue en 1867, avait donné une révision générale des Lichens, des Mousses et des Algues de la Belgique. Mais la systématique générale des Algues n'était pas encore établie du temps de J. J. KICKX. La partie de son travail relatif aux Algues quoique très remarquable pour son époque, n'a plus qu'une valeur régionale et historique. KICKX mentionne 405 Algues trouvées en Belgique. Les circonstances dans lesquelles travaille DE WILDEMAN lui furent favorables, car malgré les changements survenus dans la systématique des Algues, les grandes lignes en étaient établies. De ce fait, la flore de DE WILDEMAN a encore une valeur de nos jours. L'apparition de ce travail en 1896 était une étape des plus importantes. En 1897 DE WILDEMAN publie le „*Prodrome de la Flore algologique des Indes néerlandaises*, la supplément paraît en 1899. Enfin, en 1900, les „*Algues de la Flore de Buitenzorg, Essai d'une flore algologique de Java*”. C'est le premier grand travail d'ensemble sur les Algues d'une contrée tropicale. Dans ses recherches ultérieures, DE WILDEMAN s'intéresse de plus en plus aux phanérogames du Congo Belge et aux plantes de grande culture. Le nombre de ses publications concernant les Algues diminue d'année en année. De temps en temps il se rappelle ses premières sympathies, mais on ne peut plus considérer DE WILDEMAN comme un algologue. C'est un botaniste de premier plan qui publie par intervalles une étude se rapportant aux Algues. Mais si DE WILDEMAN a orienté son activité vers d'autres sujets d'étude, les travaux algologiques de sa première période sont si importants qu'il restera toujours un des grands algologues du 19<sup>me</sup> siècle et la Belgique peut s'enorgueillir de ce savant, un des plus éminents algologues de son époque.

P. VAN OYE.

## BIBLIOGRAPHY

P. VAN OYE: *La vie du Plancton dans les eaux courantes*, Bull. Soc. Bot. du Nord de la France, 1, 1948, 1-7.

The author gives a short historical account of hydrobiological research in France, with some critical remarks on terminology used in this branch of science; J. COMERE's work, unsufficiently appreciated in France, is discussed more fully. Some remarks follow on the periodicity of the plankton with examples from author's own research in Northern France; details of a water-examination are given, and the theoretical and practical importance of this is emphasized. Author's conclusion is that the plankton of the running water, although it sometimes has its origin in stagnant water, possesses nevertheless its own life, which is influenced by the environmental factors and which primarily is the expression of the state of purity of the water.

FRIEDRICH HUSTEDT: *Die Struktur der Diatomeen und die Bedeutung des Elektronenmikroskop für ihre Analyse*, Arch. f. Hydrob., 41, 1945, 314-332, 1 pl.

### Summary.

1. Diatoms very often possess, as a structural element, prismatic chambers with a polygonal (mostly hexagonal) section, open on the one side, the other being closed by means of a poroid membrane.

2. The structure of most of *Coscinodiscus* species is very near to that of the group of *Triceratium sendaiense* and *Tr. formosum*, which leads to the admission of a close relationship.

3. The opening of the chamber is located either on the inner or on the outer side of the cellular wall, both of these structures being sometimes found within the same genus.

4. The above described prismatic chambers are found in both the centric and the pennate (e.g. *Diploneis*) diatoms, in which last they are subject to many variations.

5. The chamber-walls are reduced in some species, even atrophied; reductions to a column-like communications between the walls have not been observed.

6. The chamber-openings are adapted to the respective contour of the chamber-section; splitlike openings over prismatic chambers have not yet been found.

7. Isolated pores and poroid canals are used for mucus excretion. There is neither a minimum nor a maximum size to be accepted for the pores used for assimilation.

8. Several objections could be raised against the structure of the cellular wall of *Pleurosigma angulatum* as accepted by MULLER and PASEWALDT. A different significance of the pictures obtained electronoptically leads to the conclusion that in these diatoms, too, the cellular wall is composed of prismatic chambers with a large opening on one side the other side being closed by a poroidal membrane.

FRIEDRICH HUSTEDT: *Diatomeen aus Seen und Quellgebieten der Balkan-Halbinsel*, Arch. f. Hydrob. 40, 1945, Heft 4, 867-973, 3 tables, pl. XXXI-XLIII.

The diatoms-flora from eleven localities is examined, with a systematical chapter; 441 forms are listed, in 346 species and 39 genera, of which 50 species and 6 varieties are described as new. The genus *Navicula* with 96 species represents alone 28% of the listed forms. Other important groups are *Eunotia*, *Pinnularia*, *Cymbella*, *Achnanthes* and *Gomphonema*. The

geographical distribution of the observed diatoms is also examined: a single northern european species (*Campylodiscus levanderi*) exists in the area and there are 59 endemic forms. These are examined in detail.

FRIEDRICH HUSTEDT: *Die Diatomeenflora norddeutscher Seen mit besonderer Berücksichtigung des holsteinischen Seengebiets*, Arch. f. Hydrob. 41, 1945, 392-414, 2 tables.

A number of lakes in Posen, Neumark, Pomerania and Brandenburg are examined with regard to their diatoms-flora, with lists of the observed forms.

P. BOURRELLY: *L'Algothèque du Laboratoire de Cryptogamie du Muséum*, Catalogue des Collections Vivantes, Herbiers et Documents, I, L'Algothèque, Mus. Nat. Hist. Nat., Lab. de Cryptogamie, Paris 1948, 20 pp., 12 fig.

A short description of the technique of clonic culture of microscopic algae, with lists of species cultivated, of which there are 90 belonging to the most families.

P. BOURRELLY: *Algues rares ou nouvelles de la forêt de Sénart*, Bull. Muséum, 2e série, 19, no. 6, 1947, 464-470, 1 pl.

Six species are examined, among which *Salpingoeca serpettei* is new.

P. BOURRELLY: *Algues rares et nouvelles des mares de la forêt de Fontainebleau*, Rev. Gén. Bot., 54, 1947, p. 506 (1-20), ppl. III-VII.

Description of 37 forms found in the forest of Fontainebleau; new are: *Mallomonas leboimii*, *Phacus agilis* SKUJA var. *inversa* and *Elakatothrix* (?) *minouchetii*.

C. MOTAS & Madame J. TANASACHI: *Un nouveau nom pour Stygomonia latipes* SZALAY 1943, Bull. Sect. Scient. Ac. Roum., 29, 1947, no. 9, 600-601.

SZALAY's description and figure of the hydracarian *Stygomonia latipes* being unsufficient, the authors who previously have given a more complete description, propose to change the specific name into *szalayi*.

C. MOTAS, Madame J. TANASACHI & TR. ORGHIDAN: *Hydracariens phréaticoles de Roumanie*, Notationes Biologicae, 5, 1947, no. 1-3, 1-67, 26 fig.

Very detailed notices on 13 rare or new hydracararians, with lists of forms collected in Rumania during the last years, some zoogeographical remarks and a list of the 45 species hitherto found in phreatic waters of Rumania.

C. MOTAS & Madame J. TANASACHI: *Acariens phréaticoles de Transylvanie*, Notationes Biologicae, 4, 1946, no. 1-3, 3-63, 91 fig.

Very detailed notices on 11 species, with description of six new species and one genus: *Charonthrombium racovitzae* n. gen. n. sp., *Kawamura-carus chappuisi* n. sp., *Megapus latipalpis* n. sp., *Aturus paucisetus* n. sp., *Konsbergia pusilla* n. sp. and *K. pectinigera* n. sp. A list of the 26 species hitherto found in the subterranean waters of Transylvania is given.

C. MOTAS, Madame J. TANASACHI & TR. ORGHIDAN: *Diagnoses de quelques nouveaux hydracarariens phréaticoles de Roumanie*, Ac. Roum., Bull. sect. scient., 29, 1947, no. 8, 506-512.

Description of a new genus (*Erebaxonopsis*), 6 new species (*Atractides jeanneli*, *Erebaxonopsis brevipes*, *Axonopsis vietsi*, *A. inferorum*, *Albazona lundbladi*, and *Neocarus stygobius* (female) and 2 new varieties (*Konsbergia pectinigera* var. *sinuosa* and *Feltria cornuta* var. *paucipora*).

C. MOTAS, Madame J. TANASACHI & TH. ORGHIDAN: *Un hydracarien nouveau de Roumanie: Frontipodopsis transylvanica* n. sp., Ac. Roum., Bull. sect. scient., 29, 1947, no. 1, 29-34, 4 fig.



Description of a new hydracarian belonging to the genus *Frontipodopsis*, of which only two species have hitherto been known, both from South America.

C. MOTAS, Madame J. TANASACHI & TH. ORGHIDAN: *Un nouveau hydracarien phréaticole recueilli en Transylvanie*, Ac. Roum., Bull. sect. scient., 29, 1947, no. 5, 304-307, 3 fig.

Description of a new genus (*Persephonacarus*) and of a new species (*P. stygobius*), the first phreaticole hydracarian to possess swimming setae.

C. MOTAS & Madame J. TANASACHI: *Balcanohydracarus alveolatus* n. gen. n. sp. hydracarien phréaticole nouveau recueilli en Yougoslavie, Ac. Roum., Bull. sect. scient., 30, 1948, no. 6, 357-360, 1 fig.

Description of a new genus (*Balcanohydracarus*) and of a new species (*B. alveolatus*), from Bosnia, probably belonging to the family Athienemaniidae.

C. D. BOGOESCO: *Un genre nouveau l'éphéméroptère trouvé en Roumanie*, Ac. Roum., Bull. sect. scient., 29, 1947, no. 9, 602-606, 5 fig.

Description of a new genus (*Pseudocentropitulum*) and of a new species (*P. motasi*) (female and nymphs) intermediary between the genera *Centropitulum* and *Baëtis*.

Z. FEIDER: *Un nouveau thrombidion: Simachothrombium motasi* n. sp., Ac. Roum., Bull. sect. scient., 27, 1945, no. 8, 533-538, 7 fig.

Description of a new genus (*Simachothrombium*) and of a new species (*S. motasi*) of the family Thrombidiidae.

N. BOTNARIUC: *Révision des phyllopodes conchostracés de la collection du Professeur I. Borcea*, Ac. Roum., Bull. sect. scient., 28, 1946, no. 8, 555-561, 4 fig.

Discussion of some material left by the late Prof. I. Borcea and containing 5 species of Phyllopoda Conchostraca collected in Rumania.

EMANUEL BARTOS: *Some new Bdelloid-rotifera from the bohemian mosses*, Folia Entomologica, 11, 1948, 17-23, 14 fig.

Description of the following new Bdelloid Rotifers collected in moss in Bohemia: *Habrotrocha trilobata*, *Macrotrachela pilousi*, *M. samali*, *Mniobia storkani*, and *M. punctulata*.



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The Annuary contains, besides obituaries and summaries of the lectures delivered at the monthly meetings of the Society, a paper by Prof. van Oye: Considerations on biological teachings in Belgium, and scientific papers in English, French, German and Dutch; among these last, the following are concerned with Hydrobiology: J. Th. Koster (Leiden) on the collection of algae in the Leiden State Herbarium, with a historical sketch, a description of the principal herbariums kept at that institution; A. Middelhoek (Enschede) on *Chromulinella Rosanoffii* (Woronin) Bütschli, a flagellate recently added to the microfauna of the Netherlands; P. van Oye (Ghent) on the Belgian rhizopoda, giving a bibliography on the subject and a list of species found in Belgium.

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